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Engineering News-Record

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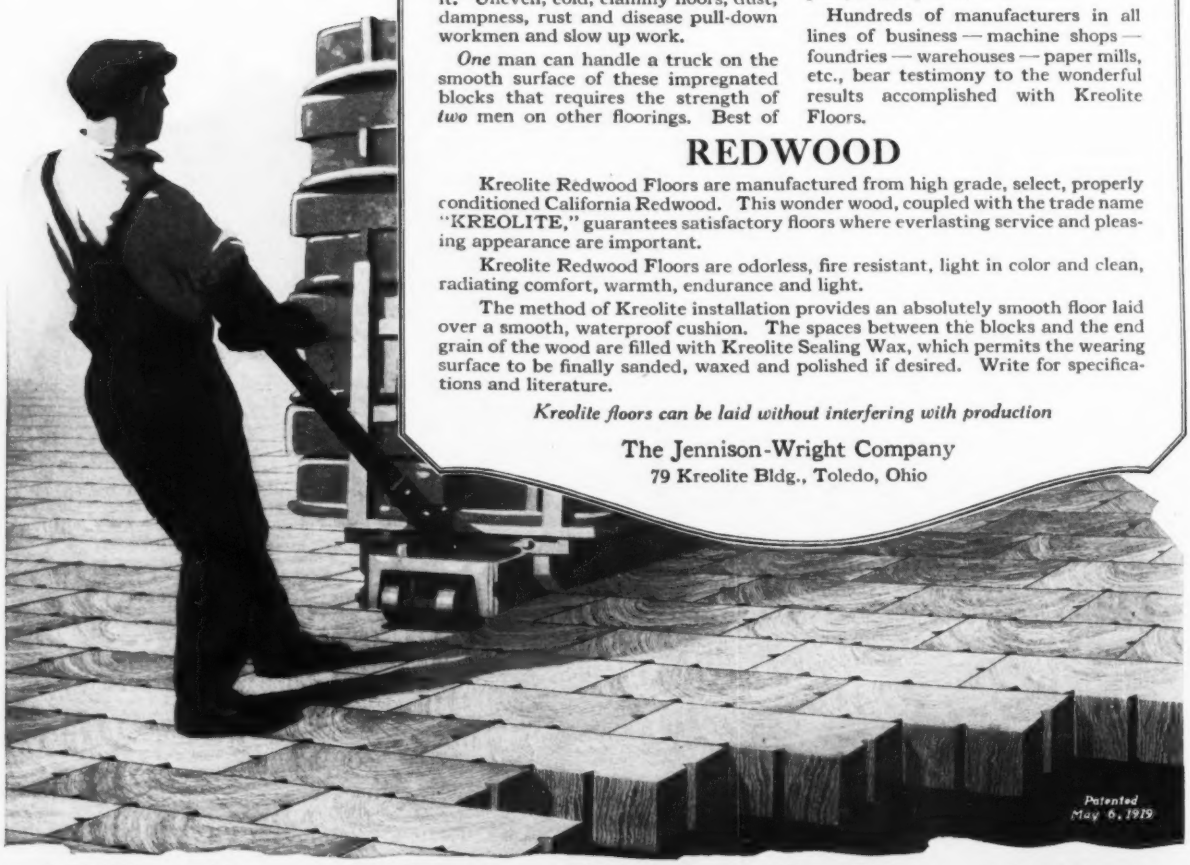

WOOD BLOCK FLOORS

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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The Spirit of Christmas

HOW clouded have been the Christmastides of recent years! We have tried hard to throw ourselves into them wholeheartedly, but always there has been the shadow of great disturbances. The first Christmas with this clouded background was that of 1914. The oppression of war increased in the following years until 1917 our hearts were overseas and Christmas was a prayer for those whose lives were in the balance. Then the relief of 1918, to be followed by holiday seasons darkened more and more by hunger, starvation, economic ruin.

This year there is less war and there is less of hunger, less of actual starvation, but more of economic ruin. Central Europe is near despair. The hates of the war have become the hates of peace, preparing for new war. The ententes of war days have become the distrusts of the pseudo-peace.

Nor if we look at home can we find relief. There is no war here, it is true; hardly even hate. But of distrust there is much, distrust between employer and employed. The consequences of the great strikes are still with us; the omens betoken another great conflict in prospect.

Is there a panacea? Our answer always is that there is no panacea. In practice that is true, and it is true not because a great remedy does not offer, but because we humans refuse to accept the remedy. There is a panacea, if we would but convert the world, ourselves, to its use. That panacea is the spirit of Christ—the spirit that the Christian world will celebrate and praise next Monday, but which it fails to carry into action. That spirit, His spirit, is the negation of hate. It teaches us that we must not covet our neighbor's goods. It tells us that we must do to others as we would be done by.

Idle words? Ah, no. Good words on idle ears.

The hope of the world—the warring economic world of Europe, the strifeful economic world here—is in the adoption as an active force throughout the entire year of the spirit we turn to on Christmas, the spirit of Christ, of love one to another.

The Season's Greetings

THIS week will find the mail of each reader of *Engineering News-Record* swelled with greeting cards. From far and near they come. Here is one from a business acquaintance, there one from a companion of boyhood joys and griefs, another from a relative separated by a continent's or an ocean's span.

One and all they bring the cheery greeting of Christmas. They radiate good will. They tell us that at this season we forget our particular daily cares and expand into the spirit that embraces the whole Christian world.

In this welcoming group, with those friends who are wishing you a Merry Christmas and prosperity in the New Year, *Engineering News-Record* wishes to be included—yes, included as a friend. And surely the editors have a right to feel that their greeting will be welcomed, for never in the history of the paper, or that of its lineal predecessors, have we had a year in which you have shown so much interest or given us so much co-operation. We have had occasion as never before to ask your advice and assistance. Through questionnaire and letter we have called on you for help, and most generous has been the response.

Therefore, our Christmas greetings are freighted not merely with good wishes for the great day and for the future but with our sincere gratitude for your support and assistance. You have been most generous. Without you our efforts would have been less fruitful. We thank you and pray for you the choicest blessings of Christmas day—happiness and the peace which surpasseth all understanding.

State-Owned Power Again

SINCE his election last month Governor-elect Smith of New York has several times taken occasion to emphasize his intention to insist on the state's owning and controlling all of its water power resources. State control of water power, he says, was one of the tenets of the Democratic platform and therefore becomes a command to a candidate elected upon that platform. This is, of course, the proper political attitude, and no one can doubt the governor's honest intent. The issue, however, is much too big to be blanketed in a party platform and to be settled by a vote which was affected by a dozen other conditions quite unrelated to water power. It deserves a special referendum of its own, just as it had last month in both California and South Dakota. It is easy to inveigh against the exploitation by private interests of the great power resources of the state, but when a definite state ownership program is submitted, the complications become apparent and the voters are apt to follow the lead of California, where a comprehensive state owned power system was rejected and of South Dakota, where a specific state-owned plant was turned down. New York should profit by the example of its sister states.

Steelwork and Weather Exposure

SUMMARIZING years of experience in maintaining large steel outdoor structures, an engineer recently stated that the older structures under his care have proved to be seriously lacking in resistance to weather exposure, due to certain minor details. Excessive spacing of stitch rivets was his principal point of criticism; the riveting fails to draw the component parts of the steel members into contact tight enough to prevent

moisture entering and rust beginning, and, corrosion once started, its wedging effect due to volume expansion as oxygen is taken up produces a further spreading of the plates and facilitates the destructive process. Closer stitch riveting in the later structures has virtually eliminated this trouble. The widely spaced riveting was laid out with a view to the structural strength of the uncorroded part, in other words for proper strength under indoor conditions, but it proved inadequate in the long run for outdoor exposure. It happens, unfortunately, that current designing rules do not differentiate between the requirements of indoor and outdoor exposure. At most they recommend taking account of the effects of the weather by adding a certain thickness of metal for loss by rusting—an oldtime rule whose value today is rather questionable. As the experience above quoted indicates that exposure resistance may depend on the detailing, there appears to be opportunity for improving the rules of practice. In preparation for such improvement, it would be of value to have the question illuminated by notes from the experience of other maintenance engineers.

Wide Piers on the Pacific

SEEMINGLY the port development technique developing on the Pacific Ocean differs materially from that on the Atlantic. It has for its basis long and wide piers, over 300 ft. in width in many cases, amply covered with tracks and warehouses, with full equipment of railroad tracks both on the piers and in the approach area, which may be devoted to warehouses or to factories. The type is well developed at Seattle and Vancouver on the east shore of the ocean, with similar tendencies at such minor ports as Astoria and Los Angeles, and now we see from the latest report from Kobe that Japanese engineers are following with an accuracy typical of their nation the principles of pier layout made familiar in the English speaking Pacific ports. European ports do not run to piers for ship docking so there is little comparison there but the great Atlantic American ports have been most reluctant to adopt the wide and long pier now apparently standard on the Pacific. Philadelphia and Boston have gone further in this respect than New York, but none show such structures as either Kobe or Seattle, though advanced port thinking indicates that the piers at the latter port should be most satisfactory for easy and economical freight handling and transference.

Survival of the Stronger

IN THESE days of automobile crowding and speeding, it need not be surprising if we read that a car in trying to cross a bridge missed its aim at the clear roadway and struck the bridge instead, as happened in Central Pennsylvania recently. Nor is there much ground for being alarmed at hearing that the bridge succumbed under this treatment and fell into the river. A single accident of the kind does not throw doubt on the strength of highway bridges generally. But when a second accident of precisely the same kind happens within a few weeks not many miles from the location of the first, the matter becomes almost sensational. In any clash the stronger contestant is apt to survive and the weaker fail; and it now appears that in a clash of automobile and bridge, the bridge proves to be the weaker—the automobile in some fashion survives, but the bridge goes down. This is likely to be a disillusionment to the people who pay for bridges and use them. They expect a bridge to weather both the fair and the foul. Bridge builders doubtless have the same idea. But their conventional rules and principles of bridge design contain nothing about making a bridge strong enough to resist the shock of a colliding automobile; there is much hairsplitting detail about loads, dynamic effect of traffic, wind action, and the like, but not a word concerning the trouble-making potentialities of even a Ford roadster run amuck. Obviously, if all the careful proportioning for normal service does not make a bridge strong enough to withstand the rough handling of day-by-day existence, its practical value is open to question. If collisions will happen, the bridge should not go down, whatever becomes of the car. As to the chance of such collision, everyone who has rounded a sharp turn and seen a narrow bridge coming toward him at the rate of some forty feet per second is sure to have a lively sense of the possibilities. Unless the two Pennsylvania wrecks are so exceptional as to merit no further consideration, we must either provide mechanical traffic guidance at bridges, or we must build the bridges strong enough for the colliding vehicle.

A Complaint Without Particulars

WITHIN the last few weeks three of the six commissioners of the New York Port Authority have separately and publicly charged the railroads with a failure to co-operate adequately in carrying out the Port Authority's plan for the unification of port facilities. Now we learn that the Interstate Commerce Commission is to bring to bear on the roads such pressure as it may command. It is too bad that the consuming public, which is so vitally interested in the progress of the Port Authority, has not been informed in greater detail as to the plans in which the railroads have failed to co-operate. The Port Authority is so constituted and its powers are so circumscribed that if ever it is to deal successfully with the independent transportation agencies it must enjoy a considerable measure of public support. This support will not be forthcoming in the interest of general principles and vague proposals, and we suggest for the consideration of the Interstate Commerce Commission in its inquiry a policy of more definite explanation to the public as to what it would like to have the carriers do. Incidentally, it might help to learn the recommendations of the Committee on Economics and Engineering of the National Association of Owners of Railroad Securities. Composed as it was, of engineers, all eminently qualified technically, and free from commercial or political interest, this committee must have arrived at some conclusions that would be helpful. They may, for example, have worked out specific plans for the consolidation of car-floatage equipment and other terminal facilities, to which one of the commissioners has alluded. As the representatives of railroad security owners in general, they may have worked out also a basis of co-operation that would be fair to all the roads whose interests are affected. But although this report was completed several months ago it has not yet been given the publicity that was accorded to a similar report by the same committee on the Chicago situation.

Higher Pay for Government Engineers

EVERY year the deplorably low standard of pay for the engineers in the federal departments is brought before the limited audience which reads the annual reports of the heads of those departments. Between times the subject becomes one of those unpleasant topics generally recognized as unpleasant and therefore avoided by everyone but those immediately concerned. This year the departmental reports are, if anything, more insistent on the evils of under pay than ever before. Every head of a department puts this before everything else as a matter requiring immediate remedy and as an explanation of deficiency in morale or execution.

"The very heart of the government," says Director Jones of the Coast and Geodetic Survey, "is being eaten away, leaving what appears from the outside viewpoint a working organization but one which is steadily and certainly deteriorating from within." Director Putnam of the Lighthouse Service says "The legislation most urgently needed is a revision of the salaries to permit the service to attract a high grade of suitable and efficient employees." Secretary Hoover thinks that the excessive turnover in his department may be "attributed to an abnormal condition of dissatisfaction and restlessness resulting from inadequate salaries."

In the same week that these reports were being made public, the Civil Service Reform League met in Washington and in convention assembled resolved that $700,000,000 a year could be saved in Washington by "abolishing useless jobs, dismissing incompetents, providing adequate pay for adequate work, introducing modern methods and promoting only the most capable workers." While the latter part of this generalization has the same import as the plaints of the government heads, it is the first part which explains most of the delay in providing adequate compensation for the government employee, including the engineer. Money must be saved, not spent, in Washington now. Somewhere up near the top of government must be some one who looks with a cold and unsympathetic eye on any expenditure, who regards every dollar spent as a dollar wasted and who permits to go through only such appropriations as are absolutely necessary to the state.

Freely it is admitted that there may be expenditures today which save money tomorrow and savings today that will take many times their value to pay for some years hence. That, however, is the academic and general statement. What the Budget Bureau and the Appropriations Committee have to consider is that the cost of government must be reduced and the obvious and easy way to retrench is to refuse to appropriate. The government officials who feel that their departments are disintegrating under their very eyes and the civil service reformers who would save nearly a billion each year must particularize if they expect to influence a hard-boiled Congress. They must show definite increases in efficiency by increases in salaries. Congress is in no mood to believe in theories.

This is written in complete sympathy with the needs of government salary revision, especially in the technical branches, but in like sympathy for the demands on Congress and the budget makers for a reduction in expenditure. So long as the cost of government continues to increase and the field of government service continues to enlarge, it will be difficult to establish a more equitable basis of government salaries. The proposed departmental reorganization will make such rearrangement of salaries easier than at present because it will, or should, establish similar qualifications for similar work and facilitate a standard classification. It will, or should, hasten the ideal conditions pointed out as necessary by the Civil Service Reform League, and show Congress, by example rather than by precept, how to save by spending.

Meanwhile it may be pointed out that in every organization those who think and produce are paid less than those who sell those thoughts or products. The world puts a disproportionate value on getting the signature on the dotted line. The government, be it noted, has nothing to sell, at least for the coin of the commonwealth. Its workers are all producers and thinkers and they have to suffer with the rest of that class, though to be sure they suffer somewhat more than the general run in private business. Any campaign to raise government salaries must be made a part of a reform which will tend to teach those who control wages and salaries that quality controls sales just as much as does salesmanship but that in our present social and economic system those who produce quality and quantity are made subordinate always to those who make or exploit a market.

Much Heat but Little Light

IN THE course of his very helpful discussion of the fundamentals of highway department organization before the annual meeting of the Association of State Highway Officials, A. R. Hirst, state highway engineer of Wisconsin, turned aside to pay his respects to the railroads and their managers. "Most of the railroad executives" said Mr. Hirst, "are running around weeping and wringing their hands because the motor trucks and the motor buses are making it impossible for them to operate at a profit. At the same time, crops rot in the field, road crews lie idle, manufacturing plants shut down, because the railroads have no equipment to transport with when transportation is offered and needed. * * * They (the railroads) are not a pulsing part of the American business fabric but a dead body clogging the stream of progress."

As might have been expected, this criticism has not passed without comment from those whose sympathies are with the railroads. The *Wall Street Journal* in particular registers a protest that has been echoed by others like minded as to the issue. Mr. Hirst is denounced by that journal as an "agitator," an "engineer in politics," and a "merchant in grievances."

Thus does intemperance breed intemperance and intolerant criticism generate much heat but little light. For everyone knows that although the railroads are staggering under grievous burdens not of their own making, controlled as to income and outgo by governmental dictum until their credit has been seriously impaired and improvements and upkeep halted, there are all too many railroad executives who are hidebound by tradition and who would fall if judged by the standards applied in private competitive business.

Let us grant that the railroads are not a "dead body clogging up the stream of progress" and that Mr. Hirst is none of the undesirables with which the *Wall Street Journal* has linked his name. And then with good business standards let us turn to the task of developing our railroads, our highways, our waterways into an effective transportation machine.

Track Elevation on Long Concrete Viaduct at Aurora, Ill.

Burlington Railroad Builds Three-Track Structure Through City—Concreting by Dump Cars—Heavy Fills on Line and Grade Revision

A DEPARTURE from general practice in track elevation work is the construction by the Chicago, Burlington & Quincy R.R. of a three-track concrete viaduct more than 1,400-ft. long, instead of the more usual earth fill between retaining walls, to carry its line through the city of Aurora, Ill. Provision is made for widening the viaduct to carry five tracks when traffic requires. A view of a portion of the viaduct is given in Fig. 1; showing the south side at Main St. The viaduct is the city portion of a four-mile improvement which includes revision of grades and curvature and new station and freight yard facilities.

FIG. 1—TRACK ELEVATION VIADUCT AT AURORA, ILL.

Advantages resulting from the adoption of a viaduct instead of a fill are noted as follows: (1) The use of the right-of-way beneath the flat-deck viaduct for revenue-producing purposes; (2) a slight saving in cost; (3) a more attractive appearance than a continuous wall dividing the city into two parts. No decision has been made as to the use of the covered space, but propositions have been made to rent it for stores, garages and warehouse purposes. The appearance of the long row of columns will be more effective than a stretch of retaining wall, especially as many walls of this kind become unsightly owing to cracks, seepage and discoloration. When walls were proposed it was planned to build them at first of sufficient height for a three-track fill, and to extend them to full height when the two additional tracks were required. With the viaduct construction as adopted a new two-track structure will be built later paralleling the north side of the present viaduct, where the old surface tracks are now laid.

Topographically the situation is as follows: The main business portion of the city occupies a strip of level land along the south bank of the Fox River, and from this a steep slope rises to the higher ground of the residential section. At the foot of this slope runs the railway, so that as a surface line it involved fourteen street crossings, several of which were at the foot of steep inclines. A plan of the new and old lines is shown in Fig. 2. At Spring St. and High St. there were viaducts across the tracks. On the new line the fourteen crossings are eliminated, an old street bridge is replaced by a subway and two railway grade crossings are eliminated.

From the east the railway is on a descending grade of 0.2 and 0.3 per cent to the far side of the river. A short grade of 0.3 per cent then rises to give clearance over the Elgin, Joliet & Eastern Ry., beyond which the line descends at 0.3 per cent to the old grade at Montgomery, about three miles west of Aurora.

Viaduct Design—For the three-track viaduct a 23-in. deck slab is carried by three rows of columns spaced 18 ft. c. to c. transversely and 19 ft. longitudinally as shown by the typical drawing Fig. 3. Over the columns are drop panels 11 in. deep. At the streets there are three-column bents on the curb lines and in the middle of the street, giving two roadway spans 24 ft. c. to c. of columns, with a headroom of about 16 ft. In these street spans the thickness of the slab is increased to 27 in. by lowering the floor of the form, thus reducing the drop panels to about 7 in. in depth. The columns are of circular section, except that rectangular columns are used for street spans and twin rectangular columns at the expansion joints. Owing to the varying directions of the streets, the column bents are skewed at some points, thus interrupting the uniformity of longitudinal spacing of the columns. Slab decks for the street spans were poured in place as a rule, but were separated from the viaduct deck by joints.

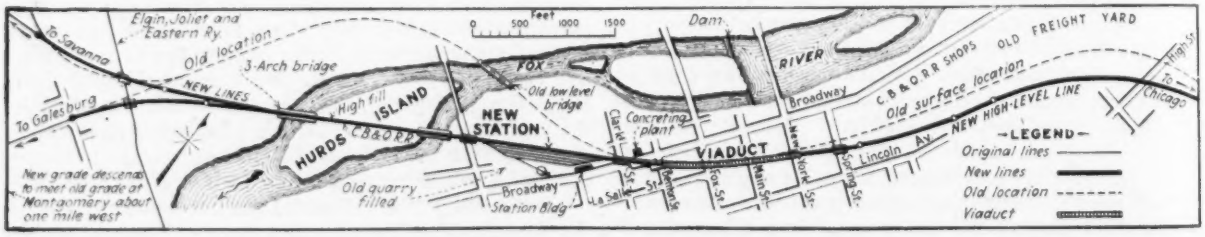


FIG. 2—RELOCATION AND TRACK ELEVATION AT AURORA, ILL.; C. B. & Q. R.R.

This viaduct was designed for E-65 live-load, including impact. In making the calculations for the slab deck the wheel loads were converted to a uniform loading of 1,675 lb. per square foot, for although this is equivalent to more than E-65 loading with tracks spaced 14 ft. c. to c. it was considered that the load might not be distributed over the full width of 14 ft. All columns were designed for E-65 loading on each track.

Viaduct Details—With a track spacing of 14 ft. the total width of deck is 44½ ft. over the curb walls or parapets. On one side is a thin vertical parapet against which are built the conduits for electric wires. On the opposite side the parapet has an inclined face and serves simply to retain the ballast. Iron handrailing will be placed along both sides. The exposed surfaces of the deck slab are flat, except for paneling at street spans, and a smooth mortar finish without form marks is secured.

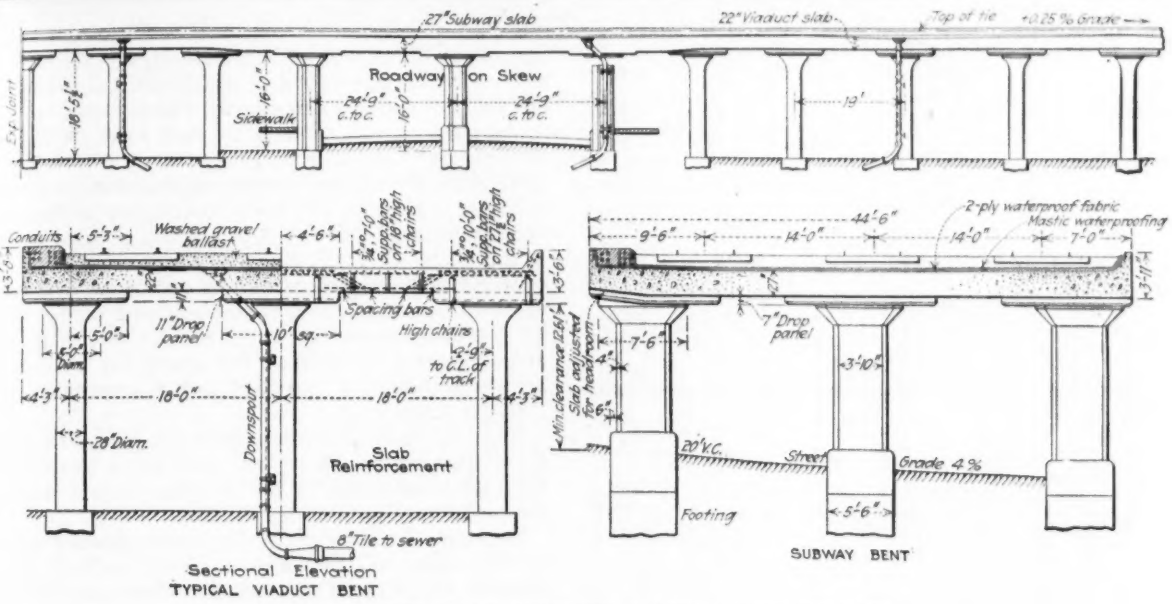


FIG. 3—THREE-TRACK CONCRETE VIADUCT, WITH SUBWAYS

Column footings are circular and are carried to rock at depths of 10 to 16 ft. These footings were poured first and then the column (see Fig. 4). The deck slab with drop panels was poured last and is anchored by the projecting vertical bars of the columns. Drainage planes formed on the top surface of the slab lead to the inlets of downspouts attached to the columns and having sewer connections. A watertight deck being essential as a roof to the covered space, not only was a waterproofing compound used in the concrete but the slab is covered with a two-ply course of waterproofing fabric and a top layer of mastic. Upon this layer will be a bed of washed-gravel ballast 6 in. deep under the ties.

Heavy four-way reinforcement is used in the deck slab, and the positive moments in the center of the panels are taken care of by bars bent down from the top at about the edge of the drop panel. Cross bars were used over all rectangular bands to equalize the stress between the various reinforcing bars in these bands. No stirrups were used. All bent bars in the slabs were bent before placing on account of the heavy reinforcement used. This bending was done in the field. In the forms, the lower bars are supported by chairs of heavy wire, while those for the top reinforcement are laid on supporting bars carried by chairs of sheet steel pressed to angle shape for stiffness.

Concreting—Gravel concrete of a 1:2:4 mix was used, with 10 lb. of waterproofing compound per cubic yard of concrete. Steel forms were used for the columns and wood forms for the slab, the latter being shown in Fig. 5. Concreting of the slab was done in sections varying from 60 to 115 ft. in length. For this work, wood joists resting on the sides of the deck form carried two standard-gage tracks for concreting trains, each train consisting of two ½-yd. bottom-dump cars, or one 1-yd. car, attached to a motor section car. A one-car train is shown in Fig. 6.

Concrete was mixed at a stationary plant near the west end of the viaduct (see Fig. 2) and having two 1-yd. mixers to provide against interruption. At first the concrete was spouted into place from a double elevator tower but when the work extended beyond the reach of the spouting system the spouts delivered the concrete to hoppers from which the dump cars were charged. The viaduct was built on the south side of the old right-of-way so that there was no interference with traffic.

Expansion Joints—Expansion joints 1 in. wide are provided at intervals of about 225 ft. No filling is

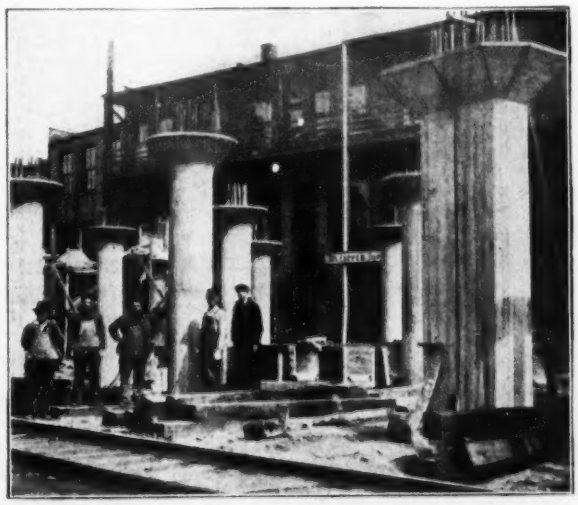


FIG. 4—COLUMNS FOR TRACK ELEVATION VIADUCT
Operated surface tracks in foreground. Twin column for expansion joint at right.

placed in the column joints, but in the deck the slot is closed by a steel plate projecting from the face of one slab and entering a groove formed by plates embedded in the face of the adjacent slab. This construction is shown in Fig. 7. A filling of flexible cement is laid upon the plate. In addition, the top of the slot or joint is closed by an apron plate 16 in. wide which is anchored on one side. Over this the waterproofing membrane is formed in a hollow rib to provide for expansion and contraction movements. For the electric conduits, each expansion joint is covered with a zinc plate and a similar plate is placed between the conduit and the curb wall of the viaduct.

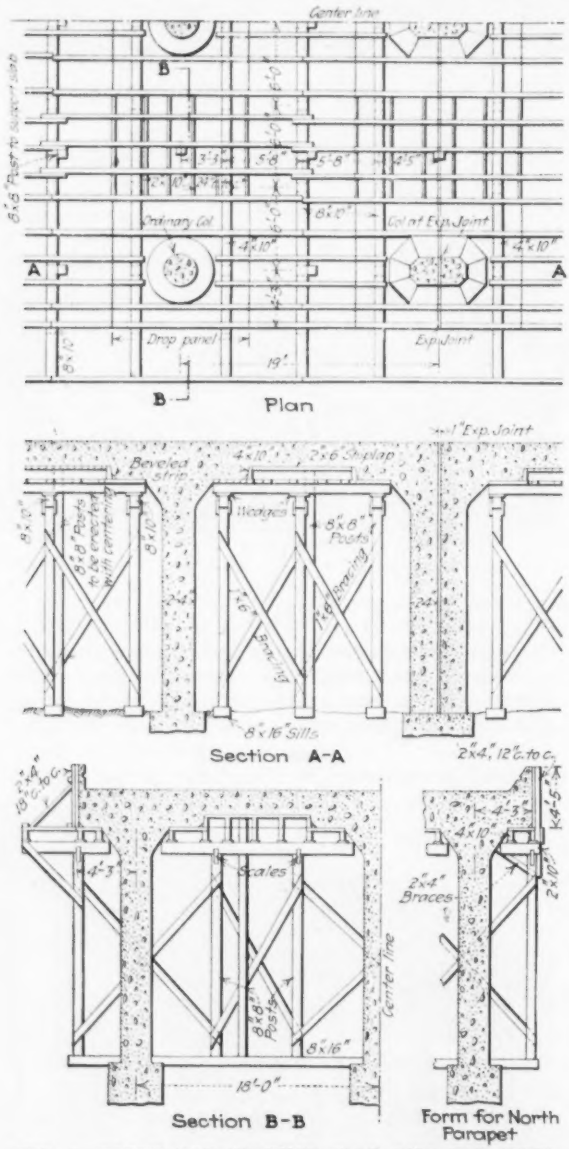


FIG. 5—FORMS FOR VIADUCT SLAB AND PARAPETS

As a rule the streets are not lowered and their grades are not changed. At some of the steep streets, therefore, the bottom of the slab of roadway spans is inclined upward on the uphill side, parallel with the street surface, in order to provide the standard headroom (see Fig. 3).

Line and Grade Improvements—Although the viaduct is the most prominent structural feature, it is only a part of the general improvement of the railway in and near Aurora. Originally the line through the city at street level was in a long sag with grades of 0.53 per cent, requiring pusher engines on heavy eastbound freight trains. Further, the right-of-way in the city was only 36 ft. wide, so that there were only two tracks on which to handle the main line and suburban (Chicago) passenger traffic and the heavy freight traffic. Difficulties of operation were increased by the fact that the lead tracks of the freight yards encroached upon the ends of this narrow space. In addition, at the west end of the city there was a long reverse-curve location with a low level bridge over the river. To improve the physical and operating conditions additional property was secured for a five-track right-of-way through the city, with an east approach practically paralleling the old line but with a grade of only 0.3 per cent.

A relocation was made at the west end (see Fig. 2), straightening the line and carrying it across a deep abandoned stone quarry which required a great amount of filling. The new line also requires two bridges over the channels of the Fox River, which is here divided by an island on which there is a high fill. These are concrete arch bridges, with two and three arches respectively of 65 ft. span, having spandrel arches which carry a concrete deck 35 ft. above the river. The piers and abutments are built of full length for a five-track bridge, but the arch spans and deck at present are only built for three tracks.

From Chicago to Aurora, 40 miles, the railway has three main tracks, the middle track being used mainly for eastbound traffic in the morning rush hours and for westbound traffic in the evening.

Subways—In addition to the streets crossed by the viaduct, eight streets are accommodated by concrete subways in the solid fill approaches. There are also two subways for the Elgin, Joliet & Eastern Ry., which formerly crossed the Burlington line at grade. Box-type abutments are used at four of these subways, each having a thin deck slab and back wall, with the roof and footing extending over and under the column bent on the curb line (see *Engineering News, March* 22, 1917, p. 473). In all cases the footings were carried to rock and the slab decks were poured in place. At Spring St., the old steel bridge over the railway is replaced by a concrete subway, the new track level being at about the height of the old bridge floor.

Slabs cast in place and having one-way reinforcement were used for the large subway at the crossing of Broadway, Clark St. and Benton St. (see Fig. 2), the three subways at this point forming practically one structure beginning at the north curb bent of Benton St. Owing to the skew of this crossing, plate girders were used along the faces to carry the ends of the skew slabs, the lines of the slabs being at right angles to the streets, so that intermediate slabs have square ends. Alternate

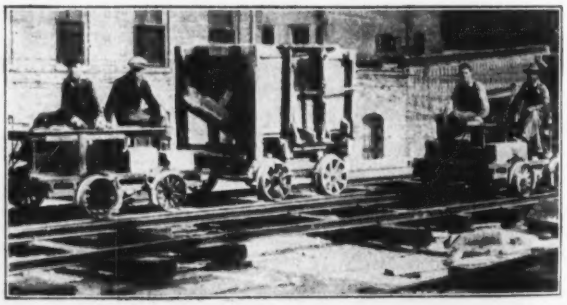


FIG. 6—MOTOR CONCRETING TRAIN WITH DUMP CAR
Tracks laid on completed slab.

slabs were poured first and paper joints provided between adjacent slabs.

New Passenger Station—No room being available for a station of adequate size on the site of the old station in the business district at New York St., a new location was adopted at Washington St., just west of the viaduct and fronting on Broadway, which is the main business thoroughfare (see Fig. 2). As Aurora is the terminal of the Chicago suburban service, provision

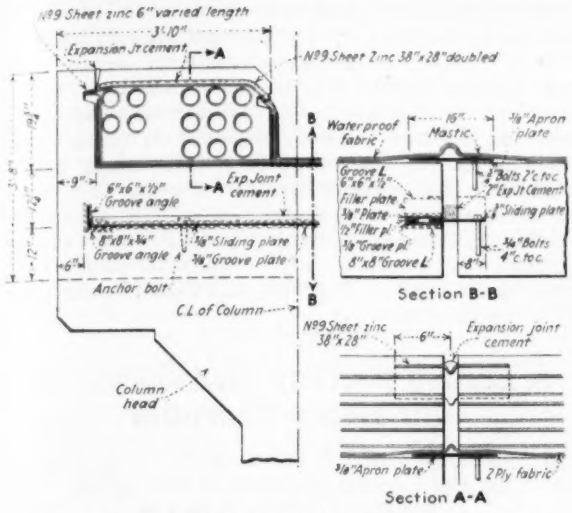


FIG. 7—EXPANSION JOINT IN DECK OF VIADUCT

is necessary for both local and through trains and for turning the engines of suburban trains. This new station has three main through tracks and four double-end local station tracks with three platforms 800 to 1,000 ft. long. The track level is reached through a subway with covered stairways to the platforms. There are also four coach tracks and a stub track having an ashpit, turntable and water column for serving the suburban engines. Platform shelters are of the butterfly type, with two rows of precast roof slabs supported on T-head columns. A two-story building provides station facilities on the first floor and railway division offices above.

The operating conditions at Aurora may be judged from the fact that there are 29 main-line through passenger trains daily, 37 freight trains and 19 suburban trains. Furthermore, Aurora is a division point, with extensive freight yards and other facilities in addition to large locomotive and car repair shops. The old city yards have been abandoned in order to provide for the enlargement of these shops, a new freight yard and engine terminal being established at Eola, just east of Aurora. In this way all switching will be kept clear of Aurora, only a shop connection and small local freight yard with team tracks being retained in the city.

The total length of the track elevation and relocation is about four miles and involves 1,500,000 cu.yd. of earth fill besides the 1,400-ft. concrete viaduct. This improvement was commenced in 1914, but was delayed by the World War. Traffic was diverted to the west part of the new line in 1921 and to the concrete viaduct in November, 1922. The viaduct was built by company force. Filling was done by Morris & Dougherty, St. Paul, and Roberts Brothers, Chicago. The station was built by G. A. Johnson & Son, Chicago.

All design and construction was under the direction of A. W. Newton, chief engineer of the Chicago, Burlington & Quincy R.R.; with C. L. Persons, assistant chief engineer. The subway and viaduct designs were prepared by G. A. Haggander, bridge engineer, and the station plans by W. T. Krausch, engineer of buildings. The construction work was in local charge of C. J. McCarthy, engineer of track elevation. The total cost of the improvement is approximately $4,500,000, of which the concrete viaduct represents about $220,000.

Wide Concrete Road Constructed Half at a Time

Light-Truck, Heavy-Truck and Industrial-Railway Haulage Compared—Center Joint Formed With Key-way and Groove

By L. E. Andrews
Assistant Civil Engineer, New Jersey Highway Department, Collingswood, N. J.

AN UNUSUALLY wide concrete road, heavily reinforced, forms the last link completed in the New Jersey across-state route from Camden to Atlantic City. With a traffic reaching on holidays as many as 9,000 vehicles in 24 hours, the pavement was made 36 and 29 ft. wide and was reinforced with 71½ lb. of bar reinforcement per 100 sq.ft. The slab is uniformly 8 in.

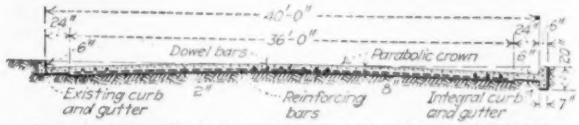


FIG. 1—WIDENED PAVEMENT SLAB ON SECTION 8

thick of 1:2:4 concrete, and as shown by Figs. 1 and 2 has a parabolic crown on a crowned subgrade.

Construction was carried on in three sections, 8, 9 and 10, respectively, 3.82, 3.76 and 5.58 miles long. The

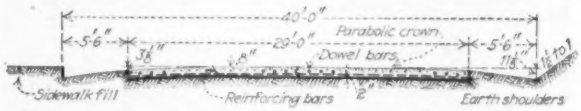


FIG. 2—NORMAL PAVED ROAD ON SECTIONS 9 AND 10

old road built over was mostly bituminous macadam on telford base and it was completely removed, leaving a uniform earth subgrade. One contractor, W. Penn Corson, Camden, N. J., is building section 8 and another, the John M. Kelley Contracting Co., Camden, N. J., is building sections 9 and 10. Except that it was required that all sections should be graded and paved half at a time thus reserving one-half of the road for hauling and to accommodate local traffic, each section was constructed by a different outfit as follows:

Section 8—Aggregates were received in barges of 500 tons capacity at Camden and were unloaded by electric crane into storage bins holding 500 tons each of sand and gravel. A fleet of 20 rear-dump trucks, each carrying all the materials for one four-bag batch did the hauling. The average one-way haul was three miles. One 21-E gasoline paver placed an average of 700 sq.yd. per day. The paved surface was designed to meet existing curbs and gutters as far as possible. The width of paving in excess of 29 ft. was paid for by the boroughs and townships concerned.

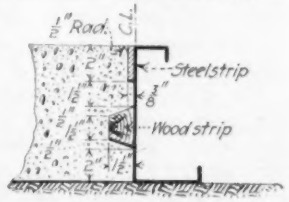


FIG. 3—CENTER JOINT, STEEL FORM AND ATTACHMENTS

Section 9—On this section industrial railway haulage from a central proportioning plant was used. The equipment consisted of two seven-ton and two three-ton gasoline locomotives and thirty industrial cars carrying two five-bag batches each. The average one-way haul was about two miles. One 21-E steam paver placed an average of 800 sq.yd. per day. All materials were re-

ceived by rail at Ashland, a point opposite the center of the job, with a dead haul of one mile. The storage bins for sand and gravel had a capacity of 150 and 200 tons, respectively.

Section 10—This, the longest of the three sections, was handled by one 21-E steam paver and one 16-E steam paver. Each paver was supplied from a separate loading yard. One yard at Lindenwold equipped with steel proportioning bins, of 75 tons capacity, supplied the smaller mixer and one at West Berlin, of 100 tons

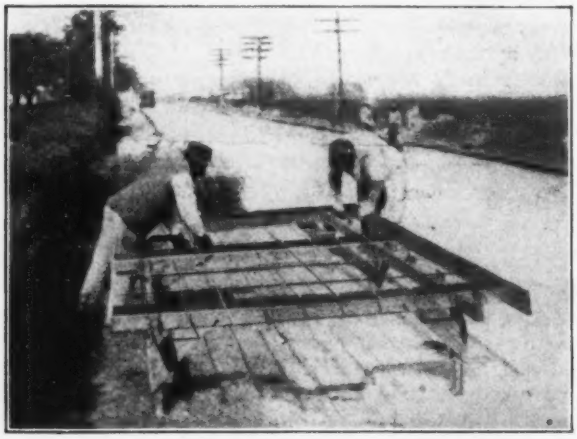


FIG. 4—FABRICATING REINFORCING MATS

capacity, supplied the larger mixer. Aggregates were delivered to the mixers in motor trucks. The average number required was five 2½-ton pneumatic-tired trucks carrying two five-bag batches and two 5-ton solid-tire trucks carrying four four-bag batches. The average daily output of the two mixers was 800 and 600 sq.yd.

Slab Fabrication—As shown by Fig. 3 the doweled center joint was obtained by bolting a wedge-shaped section of oak timber to the side form and a steel strip flush with the top edge of the form. When placing the opposite half of pavement the face of the abutting slab was painted with tar. A 2 x ¾-in. wood strip was held in the groove at the upper edge of the slab by steel pins driven into the sub-grade. After the finishing was complete and the concrete was sufficiently hardened, the wood strips were removed, leaving the desired slot which was ready for filling with bituminous mixture. This center joint slot, in addition to forming a reservoir for bituminous material, also served as a marker to keep traffic on the right of the road.

Fig. 4 shows the method of fabricating the reinforcing steel into mats 13.5 x 7.5 ft. for placing in the pavement. These mats were made of ⅝ in. deformed bars spaced 1 ft. 10.5 in. c. to c. transversely, 8.25 in. c. to c. longitudinally and weighing approximately 71.5 lb. per 100 sq.ft. of reinforcement. Two men made from 80 to 100 mats per day, the average cost of fabrication being 6.5c. per mat or about 40c. per 40 ft. slab.

Hand finishing with strike board, roller and belt was used on all three sections. Due to the narrow width of half-pavement a very good surface was obtained by the method. Wet strips of canvas were applied to the fresh surface as soon as this could be done without marring it. As soon as possible during the same day the canvases were removed and a 6-in. layer of straw or hay was applied and wet down. This was kept wet for a period of ten days and after fourteen days the pavement was thrown open for traffic purposes.

There were in the three contracts about 240,000 sq.yd. and the cost of all work was approximately $780,000.

T. J. Wasser is state highway engineer. J. J. Albertson, Camden County engineer, was engineer for the work and A. J. Williams is division construction engineer for the state highway department. Plans were made under the supervision of H. W. Griffin, survey engineer. The resident engineers for the work were F. Harris, A. J. Lichtenberg, and L. E. Andrews for Sections 8, 9 and 10 respectively. R. F. McMullin was general superintendent for the John M. Kelley Contracting Co., and S. Curriden was superintendent for W. Penn Corson.

A British Railway Man Speaks of Sir Henry Thornton

An Appreciation of His Work on the Great Eastern by the General Manager of One of the Foremost British Railways

By Felix J. C. Pole

General Manager, Great Western Railway of England

Henry W. Thornton, formerly of the engineering staff of the Pennsylvania R.R. and later general superintendent of the Long Island R.R. now returns as Major General Sir Henry Thornton from his service as general manager of the Great Eastern Railway in England to become president of the 17,000-mile Canadian National System. By invitation of Engineering News-Record Mr. Pole here records the estimate placed upon his work by his fellow railway men in Great Britain—Editor.

HENRY WORTH THORNTON has come and gone. English railwaymen were grieved at his coming, because it was heralded throughout the country as a censure upon them. The business of his advent was badly bungled, for Lord Claud Hamilton, the chairman of the Great Eastern Railway, announced to the world that on the English railway systems at that time there was a dearth of first-class men capable of fulfilling the duties of general manager. Today no one would be more ready than Sir Henry Thornton himself to admit the injustice of this aspersion upon the country in which railway operation had its birth. Indeed, he was not long in England before he had formed a very high opinion of what he had found here. Speaking in the year following his arrival he said:

"I found existing here a high standard of railway management, and it was my first duty to maintain that, which is the outgrowth of three-fourths of a century, created by the best thought of the country identified with the science of transportation. I am confronted with the record of a glorious past. To keep up to that high standard will be an honorable achievement."

As much grief as was felt at his coming is now occasioned by Sir Henry's departure. He has made good in every respect, and in nothing more than in that of *camaraderie* among officers and men. Upon his appointment he said he would begin his service in the Great Eastern Railway by endeavoring to enlist the confidence and support of every member of the staff, from top to bottom. He did this not only on the Great Eastern Railway, but in a still wider sphere as one of the Negotiating Committee of General Managers which frequently met the trade unions during the seven years in which the government were in possession of the railways. This confidence was evidenced by a recent pres-

entation which was made by the Rt. Hon. J. H. Thomas, M.P., the general secretary of the National Union of Railwaymen. A presentation by a trade union to a railway officer had never previously been made, and Sir Henry Thornton doubtless values the gold medal of the National Union of Railwaymen which is inscribed: "Presented to Sir H. W. Thornton, General Manager of the Great Eastern Railway, by members of the Executive Committee of the N.U.R., as a slight token of their regard and appreciation of his courtesy and fairness in all negotiations."

But it must not be supposed that Thornton pandered to the trade unions. When necessary they came under the lash of strong criticism, particularly in respect of lack of discipline in the trade union ranks. He described it as nothing less than a pest, and said that he and his colleagues had frequently come to an understanding with the representatives of the men on some particular question only to find that when the representatives went back to their constituents the whole thing was upset. If British trade unionism was to get on, and was to earn the confidence of employers, it must look to its internal discipline, and see that when a bargain was made by the leaders of a union that bargain was adhered to by all unionists as faithfully as by the employers.

It was early in 1914 that Sir Henry took the reins of the Great Eastern Railway, and big things were expected of him, particularly in the direction of the electrification of the lines. Within a few months of his appointment, however, the war broke out and, of necessity, changed completely the prospects of important developments. Still, the year 1915 witnessed many notable improvements on the Great Eastern Railway, among which was a drastic rearrangement of train working, the London suburban services being entirely reorganized. This was before the railways were taken over by the government. On decontrol, there was again evidence of his developing hand.

Described as one of the cleverest things done in the handling of a vast suburban traffic by steam-operated trains in and out of a London terminal, an improved service was inaugurated on the Great Eastern in 1920. The service provided a 50 to 75 per cent increase in train frequency, and was brought about by the close co-operation of the traffic and engineering departments. By close departmental co-operation—which was all along the key-note of Sir Henry's management—the seemingly impossible was successfully accomplished.

Early in 1916, Thornton became a member of the Railway Executive Committee, the body which controlled the British railways for the government. After the war period, he continued as a member of the Railway Advisory Committee, associated with the Ministry of Transport. Also in 1916, he was appointed Honorary Lieut. Colonel of the Engineer and Railway Staff Corps of Territorials. In the following year he was made Deputy Director of Inland Waterways and Docks, and afterwards Deputy Director-General of Movements and Railways, with the rank of brigadier-general. His valuable war services were recognized by his being created, in 1918, a Knight Commander of the British Empire. For the year 1921, he was chairman of the General Managers' Conference of the Railway Clearing House.

Into his railway deliberations he brought a robust spirit and a great measure of sound common-sense. For many years the attainment of efficiency in the working of British railways had been sought rather by Act of Parliament than by co-operation between the management and the staff. Enormous sums of money had been spent in the provision of complex signalling and other safety appliances, yet accidents increased in number year by year. From first to last, Sir Henry's policy was to encourage, and to rely upon a loyal and responsive staff. He believed in the dignity of service, in honest endeavor on the part of those in the position of

Photograph by International News Service

MAJ.-GEN. SIR HENRY THORNTON
President, Canadian National Railways

employees and a deep realization of their responsibilities by those in the position of employers.

He was a strong believer in taking the public into the confidence of the railway management in regard to the many operating difficulties that followed the war. In signed articles to the press he did excellent service in creating a better understanding between the public, the lay press, and the railways. His conviction was that the most valuable asset any railway company could have was a satisfied public—"people who were so pleased with what they got for their money that they came back for more."

* * *

We hope that we have not seen the last of Sir Henry Thornton in England, and while wishing him the best of luck in Canada, look forward to frequent visits from him and to see him helping to cement the good relations between the mother country and the dominions. Situated as he is, midway between Great Britain and the great dependencies of Australia and New Zealand, and with his broad outlook on men and things, no one could be better fitted than he to inaugurate an English-speaking railway congress—a movement which would have a wide appeal and a very great measure of usefulness.

Japanese Port Adds Large Unit to Harbor Facilities

Kobe Builds Four Quays with Berthing-Space for 19 Vessels and Cargo-Handling Capacity of 2,100,000 Tons—Walls Are Precast Caissons

THE present year will see completed one section of an ambitious program of harbor improvement commenced in 1907 by the Port of Kobe, Japan. The new facilities have added to the harbor berthing-space for 19 vessels and capacity for handling incoming or outgoing cargo to the amount of 2,100,000 tons. This is based on an available wharf frontage of 8,172 ft., and a unit cargo-handling capacity of 250 tons per foot per year.

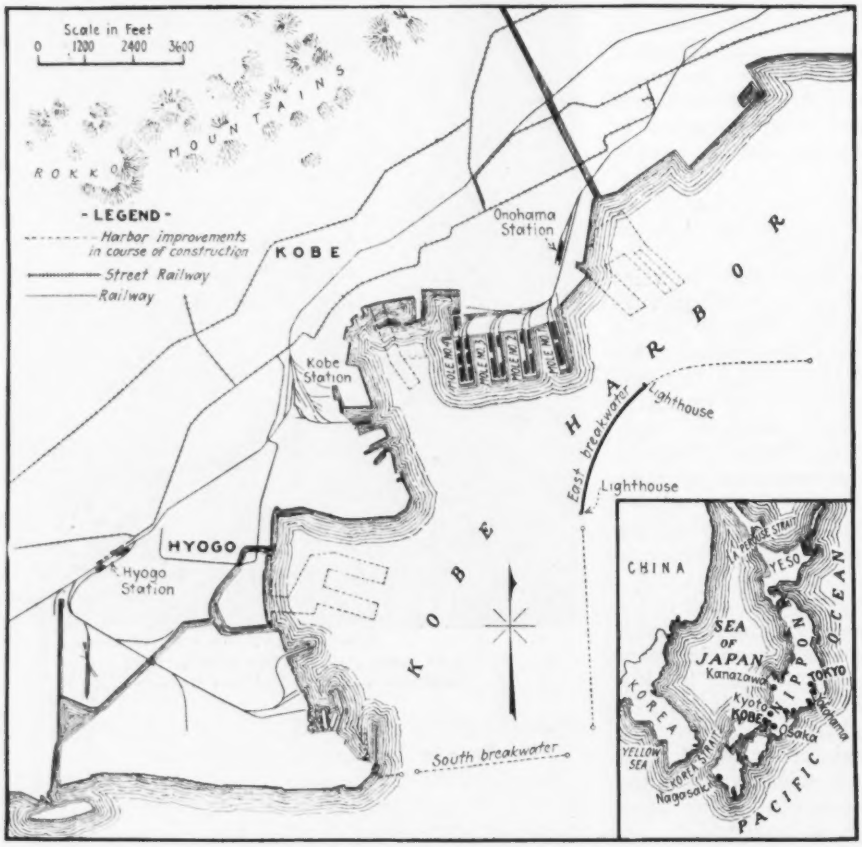


FIG. 1—GENERAL MAP OF KOBE HARBOR

The project has involved the dredging of some 270 acres to a depth of 30 to 36 ft. below mean low water and the reclamation of 65 acres which have been brought to an elevation of 11 ft. above mean low water at spring tide. The four moles which constitute the backbone of the improvement have involved the construction of 9,556 ft. of quay walls and 18 sheds, of which 16 were built on the moles and 2 on shore for the use of lighters. The sheds on the moles are of steel construction while the lighter sheds are of wood. Ten miles of railway and nearly 2¾ miles of roads provide access to the moles, each of which is equipped with traveling cranes, electric and gas lighting and water mains with numerous fire hydrants.

The new facilities have been put to use as rapidly as they have been completed. The first unit was opened in 1913. In 1920 the total volume of imports and exports for the port reached 5,544,000 tons, of which 37 per cent, or 2,066,000 tons, were handled by the new facilities. As the original object of the improvement was to provide capacity for 2,100,000 tons of cargo per annum, it will be seen that even before its completion the new improvement had practically attained its objective, a fair indication of the need for the additional facilities. Since 1873 the commerce of Kobe has shown an average increase of about 70 per cent at the end of every fifth year.

Location and Site—The Port of Kobe is situated in the southwestern part of Settsu Province, 20 miles from Osaka, and embraces Kobe and Hyogo Bays. It faces toward the south and is sheltered on the north by the Rokko mountain range, which rises two miles from the coast. The prevailing wind is from the north, but thanks to the shelter afforded by the mountains, it does not interfere with shipping in the harbor. During the winter, westerly winds sometimes visit the port, but owing to the geographical position of Wada point, they do no harm. During the summer months, however, southerly and easterly winds sweep over the expanse of open water between Kobe and Osaka, frequently causing damage to small craft. Despite this, operations in the harbor are not suspended because of rough water more than twenty times a year.

The harbor is deep with a slightly sloping bed. No stream carrying alluvial deposits empties into it and the bottom, consisting of mud and sand, affords a safe anchorage. With regard to its location, Kobe harbor is ideal, but the sudden expansion of its trade found its piers and terminals to be inadequate.

In April, 1906, as a temporary measure to meet the increasing needs of the port, plans were prepared and work commenced on a mole and steel pier at Onohama to be built in six years at an estimated cost of 3,960,000 yen. As these tentative plans proved inadequate, a more far-reaching and general plan of improvement was suggested in September, 1906, by the national Minister of Finance. The city of Kobe volunteered to bear a portion of the cost. The original plan was then altered to provide for reclamation of the foreshore from the projection of Onohama westward to the front of the former foreign concession, thereby providing facilities for the handling of 4,000,000 tons of cargo per annum. The plan provided also for modern facilities

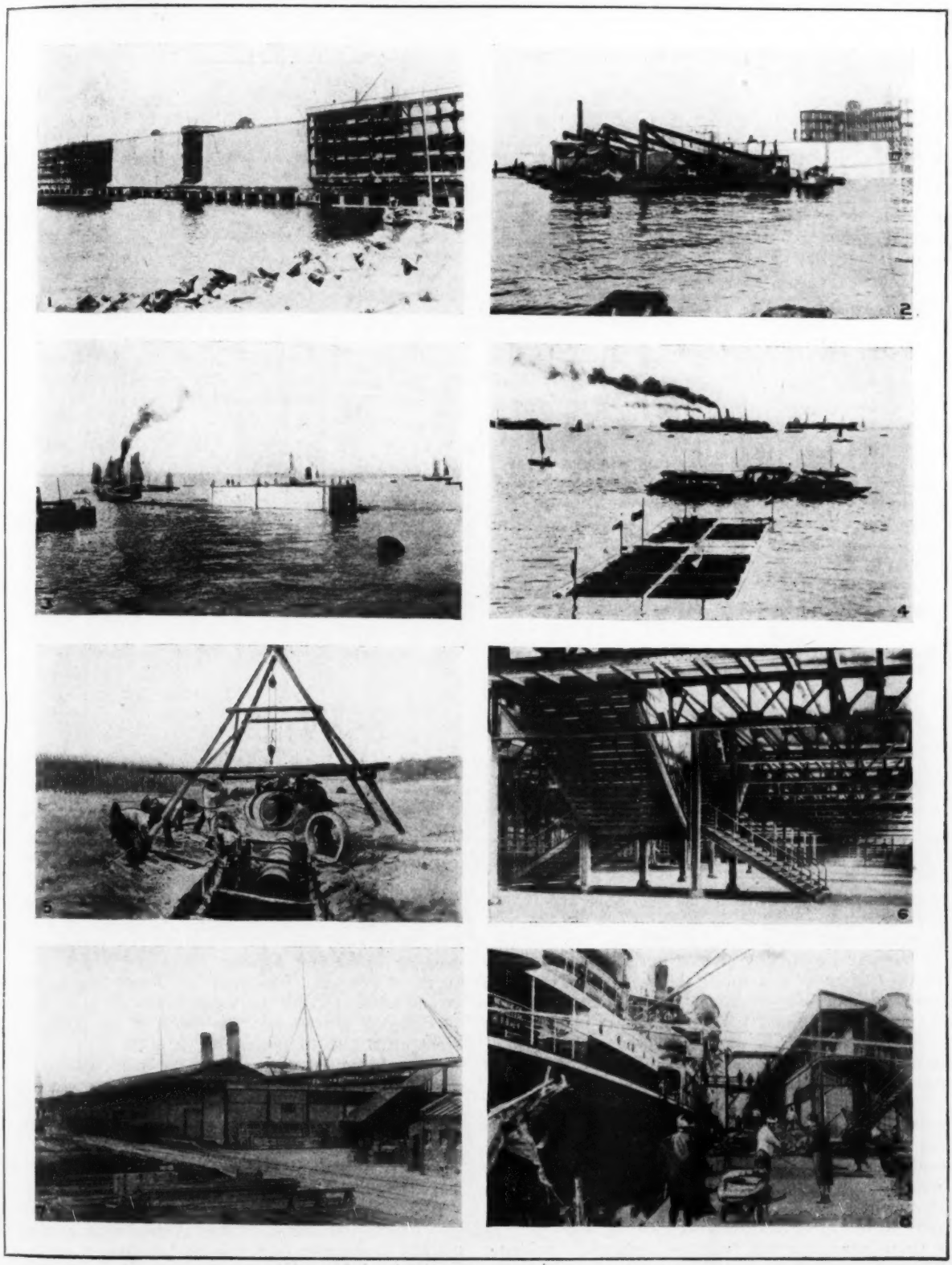


FIG. 5—CONSTRUCTION AND OPERATION OF KOBE MOLES

1. Caissons on the casting pier.
2. Caisson leaving depositing dock.
3. Caisson being towed to site.
4. Caisson being sunk.
5. Laying main sewers on mole.
6. Interior of double-decked shed.
7. Cargo handling on Mole No. 1.
8. East side of shed on Mole No. 1

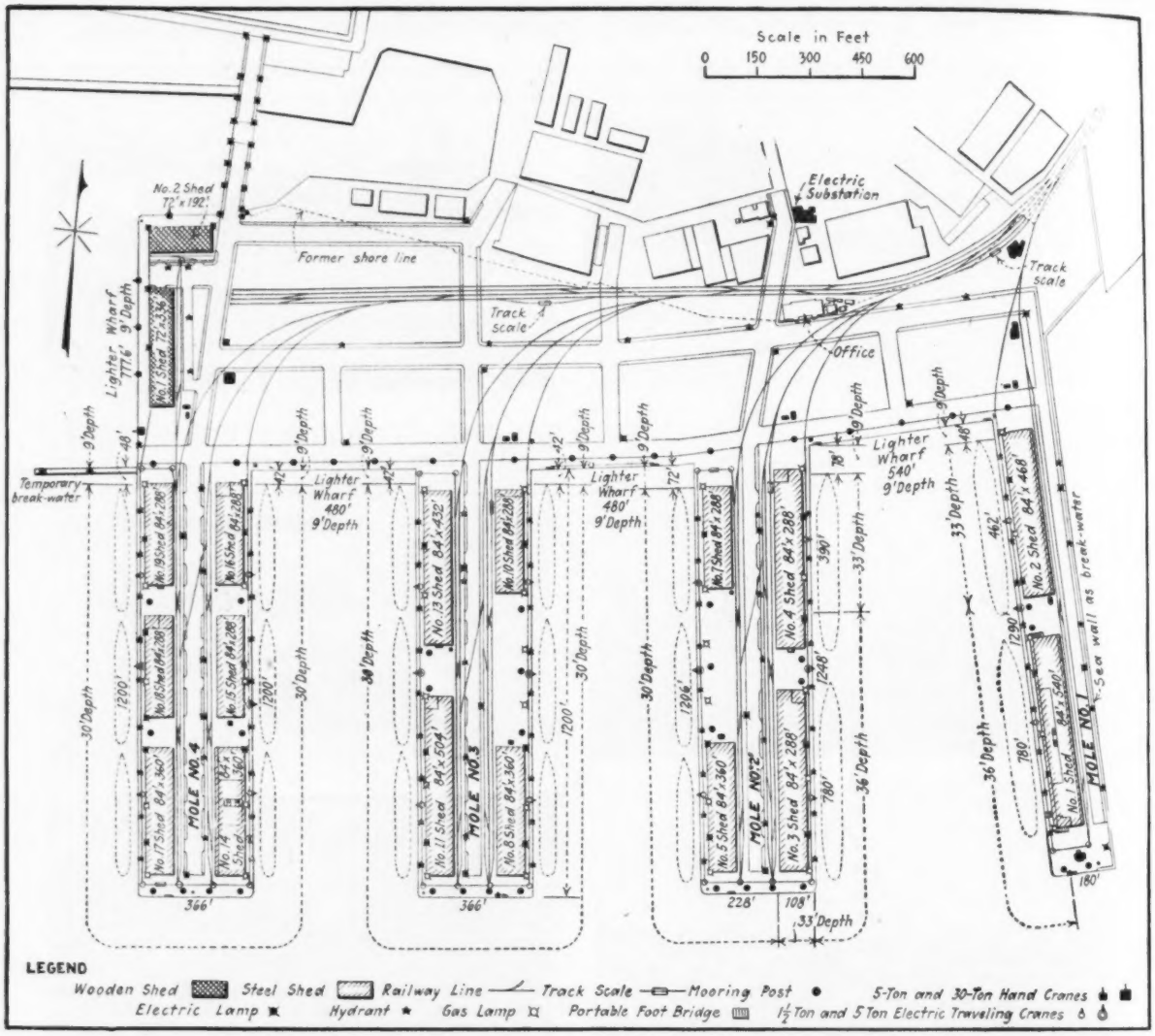


FIG. 2—NEW MOLES BUILT FROM RECLAIMED FORESHORE

to handle sea and rail traffic between Kobe and Hyogo. The estimated cost was increased to 28,905,145 yen. In March, 1907, the plan was divided into two sections.

First Section—It was decided to build first the four wharves on the foreshore of the reclaimed ground at Ono with accommodations for handling 2,100,000 tons of cargo per annum. This section was to be completed in eight years. Work was commenced on Mole No. 1 in September, 1917, but owing to the war it was found necessary to extend the time for completion.

The modified project was to build four moles as shown in Fig. 2, providing two slips each 480 ft. wide and one 540 ft. wide. Mole No. 1, at the eastern end, had its easterly side built as a sea wall to act as a breakwater with its inner side only serving as a quay. This mole is 180 ft. wide and 1,290 ft. long, while the other three are 1,200 ft. long and 336 ft. wide.

These were built out from the reclaimed foreshore. The total area of the reclaimed ground, including the moles, is about 65 acres and is 11 ft. above mean low water at spring tide. Where the four moles project, the sea has a depth of about 20 ft. Sand-pump and Priestman dredges constituted the main floating equipment for the reclamation work, which was commenced in 1907 and completed in 1921. As shown in Fig. 2, the slip between Moles No. 1 and No. 2 is mainly 36 ft. deep at low water; between Moles No. 2 and No. 3, 30 ft. at low water; between No. 3 and No. 4, 30 ft. at low water, and on the western side of Mole No. 4, 30 ft. below low water. The depth of the fairway in front of Moles No. 1 and No. 2 is 36 ft. below low water. About 60 per cent of the mud obtained by dredging was used for the lower layer of the reclaimed ground, the upper layer being of sand. The dredging was commenced in 1909 and completed in 1918. Priestman dredges were chiefly used in this work.

Lighter Wharves—Lighter wharf No. 1 is 774 ft. long, the others being 480 ft. and 540 ft. as shown in Fig. 2. These were built upon concrete blocks piled on a rip-rap foundation. Three of them slope gradually upward in order to facilitate the handling of cargo by hand to and from lighters. Between Moles No. 2 and No. 3, however, the wharf was built with a steep face in order that charging and discharging of lighters might be done by cranes. The wharves are available for lighters and launches drawing about 9 ft. of water

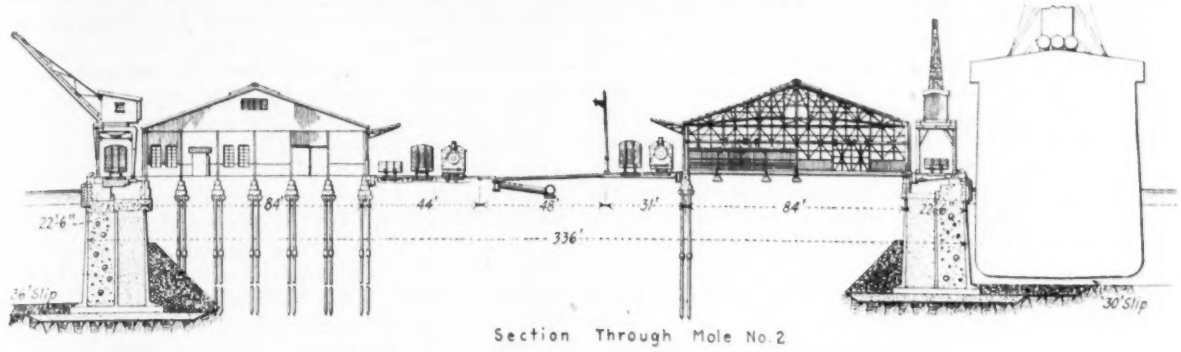


FIG. 3—SECTION THROUGH MOLE NO. 2, SHOWING TYPICAL LAYOUT

Quay-wall on left-hand side has been raised to provide for greater depth of water by the use of concrete blocks on top of caissons.

and are equipped with steel steps, portable steam-cranes or fixed hand-cranes, together with all necessary bitts and rings. They were commenced in 1908 and completed in 1922.

Quay Walls—The easterly side of Mole No. 1 was built as a sea wall of concrete blocks upon a rubble mound. It is about 2,118 ft. long and has its top elevation 17 ft. above low water. This work was started in 1907 and completed in 1914.

The total length of the quay-walls proper is about 9,556 ft. with 8,172 ft. available for cargo handling, as shown in the following table:

Quay	Height of Walls	Depth of Low Water	Effective Length	Number of Ships Alongside
Mole No. 1, south end	47 ft.	36 ft.	780 ft.	1
Mole No. 1, north end	44 ft.	33 ft.	462 ft.	1
Mole No. 2, east side, south end	47 ft.	36 ft.	780 ft.	1
Mole No. 2, east side, north end	44 ft.	33 ft.	390 ft.	1
Mole No. 2, west side	44 ft.	30 ft.	1,134 ft.	3
Mole No. 3 and Mole No. 4	41 ft.	30 ft.	4,626 ft.	12
Total			8,172 ft.	19

The sea bottom consists of soft mud to a depth of 6 or 7 ft. with layers of fine sand or hard clay underneath. The stratification, however, is not uniform which caused serious difficulty in laying the foundations of the quay-walls. It was eventually decided to build a series of reinforced-concrete caissons, the idea being to simplify the work of erection and to distribute the load over as broad an area as possible. These were built on shore and towed to the site where they were sunk by filling them with concrete and sand. At the beginning of operations, the bottom was carefully examined to determine the depth at which it would be necessary to bed the caissons and it was found necessary to dredge about 10 ft.

The caissons were built on special wooden piers resembling a comb in plan. Each was long enough to provide for three caissons, which were taken from the casting piers by a depositing dock of special design. This dock measured 145 ft. long, 137 ft. wide and 51 ft. high. Eight pontoons were attached to it, so spaced as to form the counterpart to the projections of the comb-shaped casting pier. The spaces between the pontoons were slightly wider than the projections of the pier. Each of these pontoons was of steel, 17 ft. deep, 12 ft. wide and 70 ft. long, and was equipped with the necessary valves for flooding and discharging in order to submerge or float the dock. To receive a caisson, the pontoons were pushed into the spaces left in the pier. When the dock was loaded an outrigger 4 ft. deep, 67 ft. wide and 137 ft. long served to counterbalance it.

The height of the caissons varied with the depth but most of them were designed for 30 ft. of water. These were 35.5 ft. high, 22.85 ft. wide on the top, and 120 ft. long. At the bottom, a footing 4 ft. wide and 4 ft. high was provided. Both inside and outside walls of the caissons sloped inward 1 to 20 toward the top, but the ends were vertical. On each end was cast a vertical key which provided a union with the adjoining caissons. In plan the caissons were divided into twenty chambers, formed by a longitudinal wall through its center and nine transverse walls. The two outside walls and the longitudinal wall ranged from 18 in. in thickness at the bottom to about 8 in. at the top, while the transverse walls were 15 in. thick at the bottom and 8 in. at the top. A description with drawings of these caissons and the depositing dock was published in *Engineering News*, June 1, 1911, pp. 647-648.

When in place the caissons extended 18 in. above

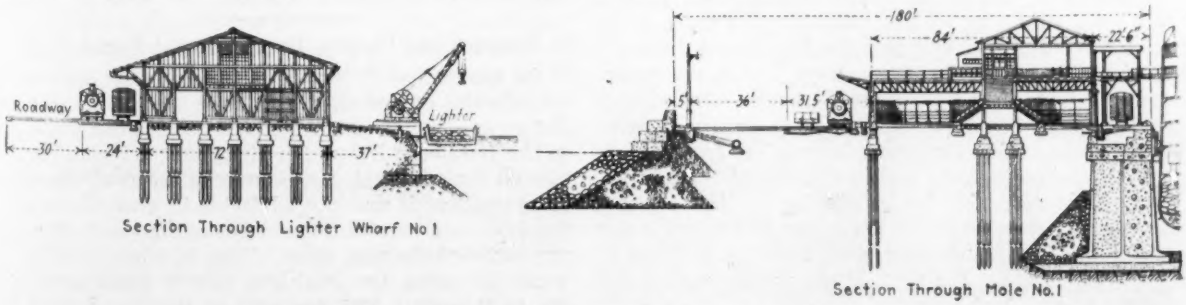


FIG. 4—SECTIONS THROUGH LIGHTER WHARF AND MOLE NO. 1

The sheds on the lighter wharves are of timber construction while those on the moles are of steel. The eastern face of Mole No. 1 has been built to serve as a sea wall, the western side only providing berthing space.

water at low tide. They were covered with a steel watertight cap and the water pumped from the front chambers, that is, those that would be on the outside of the quay wall. These chambers were then filled with concrete through a cylinder at the top of the cap and the inside chambers filled with sand. When all ten chambers had thus been filled, the caisson was completed and formed a unit of the foundation for the quay walls. Ten of these were required for each side of a mole and a space of 6 in. was left between them. This later was filled in with concrete. The weight of one caisson for 30 ft. depth of water was about 2,000 tons, while those for 33- and 36-ft. depths weighed 2,300 tons. Caissons of the same size were used in 33 ft. and 36 ft., and concrete blocks were placed upon the tops of those in deeper water to make up the difference. The total number of caissons required was eighty. Operations were begun in 1911 and finished in 1918.

Sheds—Sixteen steel sheds were built on the moles for the use of ocean-going steamers and two wooden sheds were built on the lighter wharves. Each steel shed was 84 ft. wide and from 288 to 540 ft. in length, all of them covering an area of 539,451 sq.ft. The wooden sheds had a span of 72 ft. and cover an area of 38,316 sq.ft. The sheds on the moles were built parallel to the quay-wall and 23 ft. from its face. The wooden sheds were built at a distance of 32 ft. from the face of the lighter wharves.

The floors of all the steel sheds are of asphalt and concrete and those of the wooden sheds of granolithic concrete. With the exception of two sheds, one on Mole No. 1 and one on Mole No. 4, the floors of all the steel sheds are level with the quay-wall. The two sheds excepted are of special two-story construction for passenger service. On one side of the shed there is a railway platform about 2 ft. high. All are equipped with electric light for handling cargo at night. This work was commenced in 1910 and completed in 1921.

Railway—One line of track was laid between the steel sheds and the quay-walls and two or three lines in rear of the sheds. Several storage tracks were provided on the reclaimed area back of the moles. All these are of 3 ft. 6-in. gage, total more than 10 miles in length, and are connected with the main line at the Onohama station. Twenty-one turntables of 14-ft. and 15-ft. diameter and six track scales of 30- and 24-tons capacity have been provided; and 1.6 miles of track, 13 ft. 6 in. wide, was laid along the quay walls in front of the steel sheds for the use of electric traveling-cranes. This work commenced in 1910 and was completed in 1922.

Cranes—Each quay has electrically operated traveling cranes of various capacities ranging from 1½ tons to 5 tons. These travel along the quays in front of the steel sheds and handle cargo directly to and from the hatches. On each side of the quays, two 1½-ton cranes and one 5-ton crane were installed, the total number on the moles being fourteen 1½-ton cranes and seven 5-ton cranes. Electric power is supplied from a generating station in Kobe and is distributed through underground cables by the substation in the customs compound. In addition to these, one 30-ton crane and four 5-ton fixed handcranes were installed in front of the wooden shed. The first of the cranes was erected in 1908 and the last in 1922.

Electric Light and Water Supply—Electric lights were installed along the roads of the new compound and electric as well as gas lights were installed along the quays. Water mains were laid along the quay walls for supplying vessels and along the sidewalks of the main roads numerous fire hydrants were installed. This work was commenced in 1910 and completed in 1922.

Roads and Bridges—Asphalt roads varying in width from 42 ft. to 72 ft. connect all the moles with the main business section. The total length of the roads is about 14,160 ft. On the quays and at the entrances to all sheds, granite paving was laid. A bridge 66 ft. wide and 66 ft. long and high enough to allow lighters to pass underneath was built between the northwestern part of the reclaimed ground and the main road of the former foreign concession. These operations began in 1908, were finished in 1922.

Cost—The cost of the various items here described is given as follows:

	yen
Reclamation	518,858
Dredging	221,531
Lighter wharf	263,635
Sea wall	408,759
Quay-walls (including mooring posts, bollards, steel rings and steps)	2,825,400
Sheds	2,616,210
Railway	474,211
Cranes (including substation building)	650,306
Electric lights and water supply	182,700
Roads and bridge	837,788
Total	8,999,398

The yen has a par value of 49.8c.; at current exchange it is quoted at 48c.

Staff—All this work has been under the jurisdiction of the construction section of the Department of Finance and has been carried out by the Kobe branch of the section. The responsible officers at the head office in Tokyo are K. Yabashi, director; F. Kimoto, business controller; T. Chichibu, architect; H. Inoue, civil engineer. The officers of the Kobe branch are O. Matsumoto, chief; K. Morigaki, chief engineer; J. Ikeda, architect; Y. Asai, civil engineer.

Further Improvements—Further improvements under construction and contemplated include the east breakwater, 3,792 ft. long, and the south breakwater, 3,000 ft. long, commenced in 1910 and 1917 respectively. A program now in force includes the improvement at Hyogo of facilities for domestic trade, an extension of facilities on the sea front of Hamabe-dori for foreign trade, and at Kaigan-dori for both foreign and domestic trade. More of the shore at Hyogo and Kobe is to be reclaimed and more landing and mooring places for lighters are to be provided.

The facilities for foreign trade will be provided by the national government while those for domestic trade are undertaken by the city of Kobe. The total expenditure is estimated at 41,270,000 yen of which 16,450,000 will be borne by the city of Kobe.

District and County Taxes Almost Equal Rent

An application for extra renumeration on account of considerable engineering work done outside his regular duties was recently denied to H. W. Boardman, surveyor to the Barmouth Urban District Council, Wales, on the ground that although Mr. Boardman deserved the extra compensation, it was not advisable to grant it because the local rate was 6s. 3d. and the country rate 10s. 6d. per pound of the rent value. That is, what in America would be called the local and county taxes combined are in Barmouth 83.7 per cent of the rental value of real estate, besides which there is in England a heavy national income tax.

Non-Uniform Flow and Significance of Drop-Down Curve in Conduits

A Study in Conduit Design Making Possible Flatter Grades, Smaller Conduits on Available Grades, or Cost Reduction

By H. E. Babbitt

Associate Professor of Municipal and Sanitary Engineering, University of Illinois, Urbana, Ill.

As conditions of uniform flow rarely exist at and above the outlet of conduits which do not discharge entirely submerged, the common hydraulic formulas, such as Kutter's, Manning's, etc., cannot be applied without modification for some distance above the outlet. The flatter the slope of the conduit invert, the further above the outlet will the conditions of non-uniform flow persist.

Under conditions of non-uniform flow the surface of the stream is not parallel to the invert of the channel. As a free outlet is approached the depth of flow decreases, for a constant rate of discharge, and the curve of the surface of the stream is generally known as the drop-down curve. In order to determine the depth of flow at any point, the rate of discharge, or other hydraulic elements, it becomes necessary to study the drop-down curve. This is especially important above the outlet of large conduits on flat slopes, or in studying the effect of obstructions in conduits.

It may be possible, by the study of the drop-down curve, to place conduits on flatter grades, to use smaller conduits on available grades, or to reduce the cost of outlet protection works, below the grades, diameters, or costs as computed by applying formulas applicable to conditions of uniform flow.

The factors involved in problems of non-uniform flow are: The shape of the conduit, which must be determined on other than hydraulic principles alone; and, (1) the dimensions of the conduit, (2) the rate of discharge or the capacity of the conduit, (3) the slope of the invert, (4) the depth of flow at any known point, and (5) the coefficient of roughness. In general if the shape of the conduit and any three of the five enumerated factors are known, the other two factors can be determined.

The method for determining these factors will be explained, together with the solution of an example. The nomenclature used will be:

A_n = The area of the cross-section of the flowing stream at section, n.
A_m = The mean of the cross-sectional areas of any two sections being studied.
b = The width of a rectangular channel.
C = The coefficient in Manning's formula, $V = CR^{\frac{1}{2}}S^{\frac{1}{2}}$.
D = The "diameter" or vertical height of any closed section.
d_c = The depth of flow at a "control" section, or the so-called "critical" depth.
d_l = The depth of flow at the lower of two sections being studied.
d_n = The depth of flow at any section, n
d_u = The depth of flow at the upper of two sections being studied.
g = The acceleration due to gravity.
h_f = The head lost due to friction.
h_e = The vertical distance from datum to the invert at the lower of two sections being studied.

TABLE I—COMPUTATIONS TO DETERMINE THE DEPTH OF FLOW 500 FT. ABOVE THE OUTLET OF A 3-FT. RECTANGULAR CHANNEL ON A SLOPE OF 0.001, CARRYING 100 SEC.-FT. C, IN MANNING'S FORMULA=100

Distance from Lower Section to the Outlet	Lower Section: Depth (Correct)	Lower Section: Area	Lower Section: Velocity Head	Lower Section: Hydraulic Radius	Upper Section: Depth (Assumed)	Upper Section: Area	Upper Section: Velocity Head	Upper Section: Hydraulic Radius	Average: Area	Average: Velocity²	Average: Hydraulic Radius		$\frac{\text{Slope}}{\frac{V_m^2}{(2h_m)^{4/3}}}$	Distance Between Sections*
l	d_e	A_e	$V_e^2/2g$	R_e	d_u	A_u	$V_u^2/2g$	R_u	A_m	V_m^2	R_m	$R_m^{4/3}$	S	x
0	3.28	9.84	1.604	1.03	4.22	12.66	0.969	1.107	11.25	79.2	1.066	1.10	0.0072	50
50	4.22	12.66	0.969	1.107	4.55	13.65	0.836	1.129	13.16	57.9	1.118	1.168	.00496	50
100	4.55	13.65	0.836	1.129	5.00	15.00	0.691	1.153	14.32	48.9	1.141	1.206	.00405	100
200	5.00	15.00	0.691	1.153	5.32	15.96	0.611	1.17	15.48	41.8	1.162	1.23	.00340	100
300	5.32	15.92	0.611	1.17	5.79	17.37	0.517	1.191	16.64	36.2	1.18	1.26	.00287	200
500	5.79	...	...	...	...	...	...	...	...	...	...	...	...	...
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

* $\left[\left(d_u + \frac{V_u^2}{2g}\right) - \left(d_e + \frac{V_e^2}{2g}\right)\right] \div \left[S - S_i\right]$

h_u = The vertical distance from datum to the invert at the upper of two sections being studied.
l = The distance from the outlet to the lower of two sections being studied.
Q = The rate of discharge.
R = The hydraulic radius of the conduit.
R_l = The hydraulic radius of the stream at the lower of two sections being studied.
R_m = The mean of the hydraulic radii at any two sections being studied.
R_u = The hydraulic radius of the stream at the upper of two sections being studied.
S = The value of $h_f \div x$.
S_i = The slope of the invert of the channel.
V_l = The average velocity of flow at the lower of two sections being studied.
V_m = The mean of the average velocities at any two sections being studied.
V_u = The average velocity of flow at the upper of two sections being studied.
x = The horizontal distance between two sections being studied.
y = The drop in the hydraulic gradient between any two sections being studied.

Fig. 1 shows some of the lettering used for the dimensions.

In every case the depth at the outlet, or other "control" section, must be determined. A "control" section is one at which the sum of the depth of flow (the potential head) and the velocity head is a minimum. The depth at a "control" section is known as the "critical" depth. The fact that a "control" section occurs at the outlet of all channels discharging freely or only partly submerged is demonstrated in an article "The Hydraulic Jump and Critical Depth in the Design

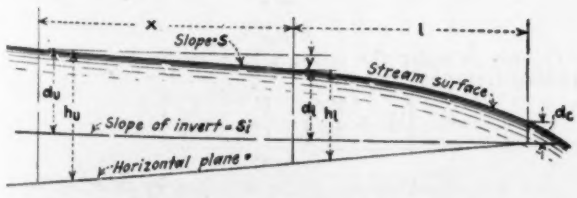


FIG. 1. ILLUSTRATION OF NOMENCLATURE EMPLOYED
Lines normal to slope of invert are presumed to be vertical.

of Hydraulic Structures," by Julian Hinds in *Engineering News-Record*, Nov. 25, 1920, p. 1034.

The critical depth for a rectangular section can be determined as follows:

By definition; depth plus velocity head equals a minimum. The depth is d_c

the velocity head is $\frac{V_m^2}{2g} = \frac{Q^2}{2gb^2d_c^2}$

therefore

$$d_c + \frac{Q^2}{2gb^2d_c^2} = \text{a minimum}$$

and, by calculus, the minimum value of the expression is obtained when

$$d_c = \frac{Q^{2/3}}{g^{1/3}b^{2/3}}$$

Values of critical depths for different widths of

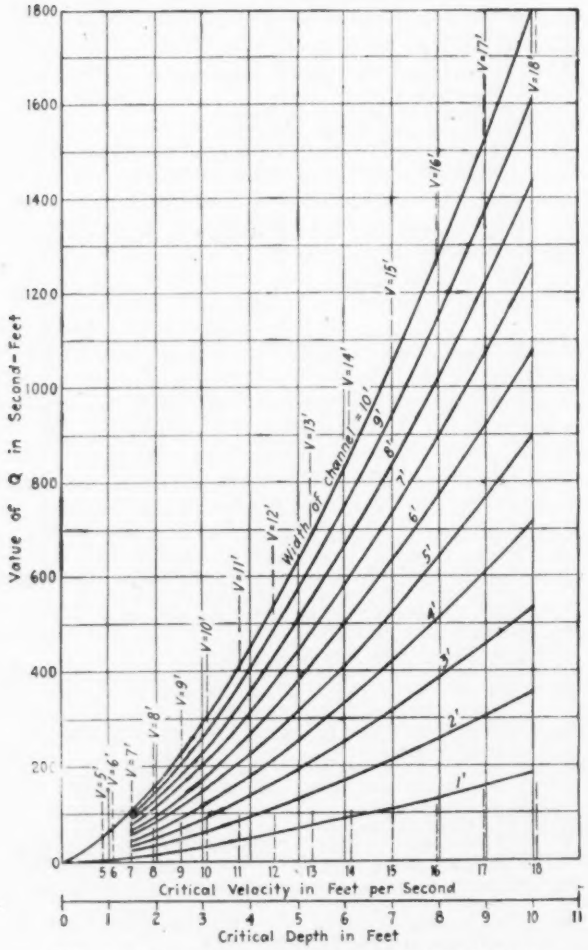


FIG. 2. CRITICAL DEPTHS AND VELOCITIES IN RECTANGULAR SECTIONS

rectangular channel, and different rates of discharge, have been plotted in Fig. 2.

V_c (the critical velocity) $= \frac{Q}{bd_c} = d_c^{\frac{1}{2}}g^{\frac{1}{2}}$ hence V_c is constant for any value of d_c. Values of V_c have also been plotted in Fig 2.

The critical depth for circular, and many irregular sections, can be determined best by a method of trial. The values of critical depths for some circular sections with different rates of discharge have been plotted in Fig. 3.

Possibly the simplest form of problem suitable for explaining the use of the drop-down curve in the study of non-uniform flow will be the determination of the depth of flow at some point in a rectangular channel of known width and material, on a known slope, and discharging at a known rate. In general the method is as follows:

TABLE II—VALUES OF Q (SEC.-FT.) FOR DIFFERENT VALUES OF CRITICAL DEPTH (FT.) AND WIDTH OF RECTANGULAR CHANNEL (FT.)

The curves in Fig. 2 were plotted from this table.

Critical Depth, Ft.	Width of Channel, Ft. 1	2	3	4	5	6	7	8	9	10
1	5.7	11.4	17.0	22.7	28.4	34.1	39.8	45.4	51.1	56.8
2	16.1	32.1	48.3	64.3	80.4	96.4	113	129	145	161
3	29.6	59.2	88.8	118	148	178	207	237	266	296
4	45.4	91	136	182	227	272	318	363	408	454
5	63.5	127	190	254	317	381	444	507	571	635
6	83.5	167	251	334	418	501	585	668	752	835
7	105	210	315	420	525	630	735	840	945	1,050
8	128	256	385	513	642	770	898	1,028	1,156	1,285
9	153	307	460	613	767	921	1,073	1,227	1,381	1,534
10	180	355	538	718	897	1,078	1,255	1,436	1,614	1,795

(1) The critical depth at the outlet is computed, or it may be read from Fig. 2.

(2) The depth of flow at a section at some unknown distance, x up stream, is assumed.

(3) The loss of head between these two sections is computed in terms of the unknown distance x, and the mean of the hydraulic radii and velocities at the two sections, by means of Manning's or some other formula applicable to conditions of uniform flow. The value of S is then expressed in terms of x.

(4) The value of x is then equated to the difference between the total heads (depth plus velocity head) at the two sections, divided by the difference between S and S_i. The depth at, and the location of, the next higher section are now known.

(5) The steps are repeated, section by section, until the depth at the required section has been determined, or the required section has been located.

As this method involves considerable computation, the figures should be tabulated. The figures for the solution of the following problem are shown in Table I.

Determine the depth of flow 500 ft. from the outlet of a 3-ft. rectangular channel on a slope of 1 in 1,000, discharging 100 sec.-ft. The material is such that the coefficient in Manning's formula is 100.

The table should be filled line by line, as follows: In Column 1 enter the distance of the known section above the outlet. In the first line this will normally be zero; in Column 2 enter the critical depth or known depth at this section; in Column 3 enter the cross-sectional area of the stream; in Column 4 enter the velocity head; in Column 5 enter the hydraulic radius of the wetted section; in Column 6 enter any desired depth, which must, however, be equal to or greater than the critical depth entered in Column 2. This depth is assumed to exist at some section up stream, the location of the section being unknown. The smaller the increment of increased depth, the greater the accuracy of the result. In Columns 7, 8, and 9 repeat the steps for the upper section that were entered in Columns 3, 4, and 5 for the lower section. In Column 10 enter the average of the areas of the two sections. In Column 11 enter the square of the average velocity, found by squaring the quotient of the rate of discharge divided by the area entered in Column 10. In Column 12 enter the mean of the hydraulic radii entered in Columns 5 and 9. In Column 13 raise the mean hydraulic radius to the 4/3 power; in Column 14 enter the value of S as expressed in Manning's formula

$$S = \frac{V_m^2}{C^2R_m^{4/3}}$$

In Column 15 enter the distance between the two sections as found from the expression

$$x = \frac{\left[d_u + \frac{V_u^2}{2g}\right] - \left[d_c + \frac{V_c^2}{2g}\right]}{S - S_i}$$

Proceed in the first column of the next line by entering the sum of the above value of x and the value of l recorded in the first column. The remaining columns are filled in the same manner as the columns in the first line.

TABLE III—VALUES OF CRITICAL DEPTHS IN CIRCULAR CHANNELS

The curves in Fig. 3 were plotted from this table.

Diam. Ft.	Q Sec. Ft.	Critical Depth Sec. Ft.	Diam. Ft.	Q Sec. Ft.	Critical Depth Ft.	Diam. Ft.	Q Sec. Ft.	Critical Depth Ft.	Diam. Ft.	Q Sec. Ft.	Critical Depth Ft.	Diam. Ft.	Q Sec. Ft.	Critical Depth Ft.
1	0.1	.13	3	2.5	.48	5	10	.87	7	25	1.26	9	50	1.71
..	0.2	.20	..	5	.66	..	20	1.19	..	50	1.79	..	100	2.39
..	0.4	.27	..	10	.99	..	30	1.54	..	100	2.56	..	300	4.14
..	0.5	.30	..	15	1.23	..	50	1.98	..	200	3.68	..	500	5.49
..	0.6	.33	..	20	1.44	..	70	2.33	..	300	4.55	..	700	6.53
..	0.8	.38	..	30	1.80	..	100	2.85	..	400	5.22	..	1,000	7.74
..	1.1	.43	..	40	2.07	..	150	3.73	..	500	5.81	..	1,200	8.24
..	1.5	.52	..	50	2.28	..	200	3.98	..	600	6.37	..	1,400	8.55
..	2.0	.60	..	60	2.49	..	300	4.65	..	700	6.55	—	—	—
..	2.4	.66	..	70	2.64	..	400	4.86	..	1,000	6.79			
..			..	80	2.73	—	—	—	—	—	—	10	50	1.60
..	2.7	.69	..	90	2.78							..	100	2.25
..	3.0	.73	..	100	2.88	6	10	.80	8	50	1.72	..	300	4.15
..	3.3	.78	—	—	—	..	25	1.29	..	100	2.48	..	500	5.30
..	4.0	.84				..	50	1.89	..	200	3.56	..	700	6.35
..	4.5	.90	4	5	.64	..	75	2.37	..	300	4.40	..	1,000	7.70
—	—	—	..	10	.92	..	80	2.46	..	400	5.04	..	1,200	8.25
			..	15	1.12	..	90	2.49	..	500	5.68	..	1,400	8.75
2	1.0	.33	..	20	1.28	..	100	2.67	..	600	6.40	..	1,600	9.25
..	2	.48	..	30	1.60	..	200	3.87	..	700	6.68	..	1,800	9.50
..	5	.80	..	50	2.08	..	300	4.80	..	800	7.04	—	—	—
..	8	.98	..	70	2.52	..	400	5.44	..	1,000	7.48	..	.....	.....
..	10	1.12	..	90	2.96	..	500	5.69	—	—	—	..	.....	.....
..	15	1.42	..	100	3.08	—	—	—	..	.....	.....	..	.....	.....
..	20	1.64	..	150	3.64	..	....	.....	..	.....	.....	..	.....	.....
..	25	1.82	..	175	3.76	..	....	.....	..	.....	.....	..	.....	.....
..	30	1.80	..	200	3.92	..	....	.....	..	.....	.....	..	.....	.....
..	40	1.94	—	—	—	..	....	.....	..	.....	.....	..	.....	.....
—	—	—				—	—	—	—	—	—	—	—	—

In the example given the depth is 5.8 ft. at a point 500 ft. above the outlet.

The practical value of the solution of the following problem is more easily comprehended though it is a trial and check method.

Determine the diameter of a circular conduit, at a point 1,000 ft. above the outlet, to carry 200 sec.-ft. The conduit is on a grade of 1 in 1,000 and C in Manning's formula is to be taken as 100.

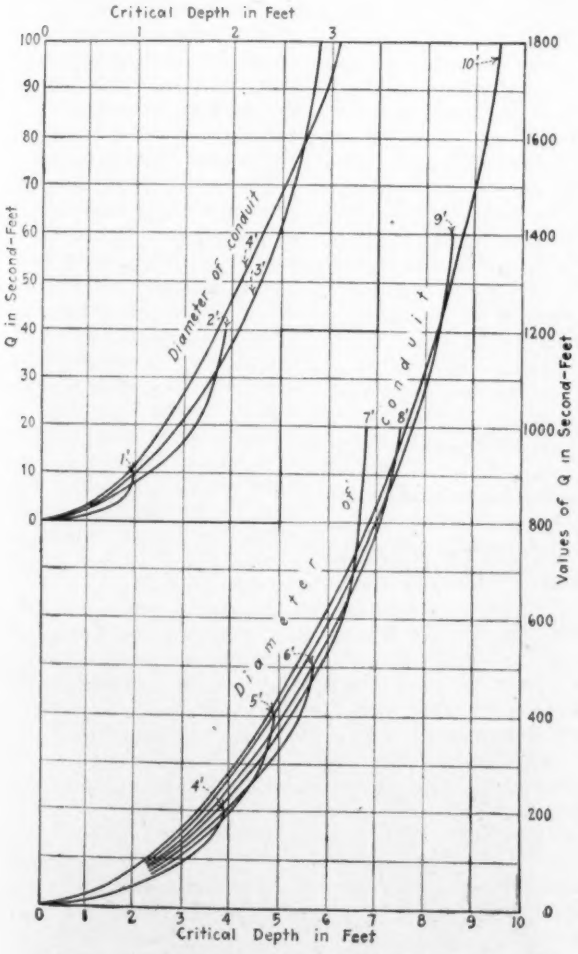


FIG. 3. CRITICAL DEPTHS IN CIRCULAR SECTIONS

The problem is solved in the same manner as the preceding example, the depth of flow at the 1,000-ft. section being taken as the required diameter. As it is necessary to know the diameter of the circle before the hydraulic elements of the sections can be computed, the required diameter must be assumed, and if not found correct, other assumptions must be made, until the assumed and the computed diameters agree. Such a method of trial would not be necessary for a rectangular channel of known width, or a triangular channel of known base angle, etc.

As computed by this method the required diameter is approximately 7 ft. As computed for conditions of uniform flow the required diameter would be about 11.5 ft. The use of a 7-ft. diameter in the place of an 11.5-ft. diameter for a distance of 1,000 ft. would make an appreciable saving.

In order to determine the capacity of a conduit, when given its dimensions and slope for some known distance above the outlet, a method of trial must be followed. The capacity is assumed and the depth at the known section above the outlet is computed as in the example solved in Table I. If the computed depth agrees with the actual depth the assumed capacity is correct. If they do not agree other assumptions of capacity must be made and the computations repeated, until the computed and the actual depths agree.

Other problems involving different combinations of the five factors, any three of which are known, can be solved by similar methods.

If the conduit is discharging into a body of water whose surface level is above the critical depth at the outlet of the conduit the actual depth at the outlet must be used instead of the critical depth. If the level of the stream into which the discharge is falling is below the critical depth, the critical depth should be used.

Jugo-Slavia Plans Railroads to Open Up Resources

Survey of Existing and Projected Transportation Facilities—American Syndicate To Finance Improvements

By Col. W. G. Atwood
Director, National Research Council

THE transportation system of central and eastern Europe was disorganized by the breaking up of the Austro-Hungarian Empire as a result of the Treaty of St. Germain. The situation in 1919 after the armistice was similar to that which would have existed in this country had all railroads terminated at the state lines and all through freight been unloaded and reloaded at each state line. Later adjustments have corrected this condition so far as interchange of equipment is concerned.

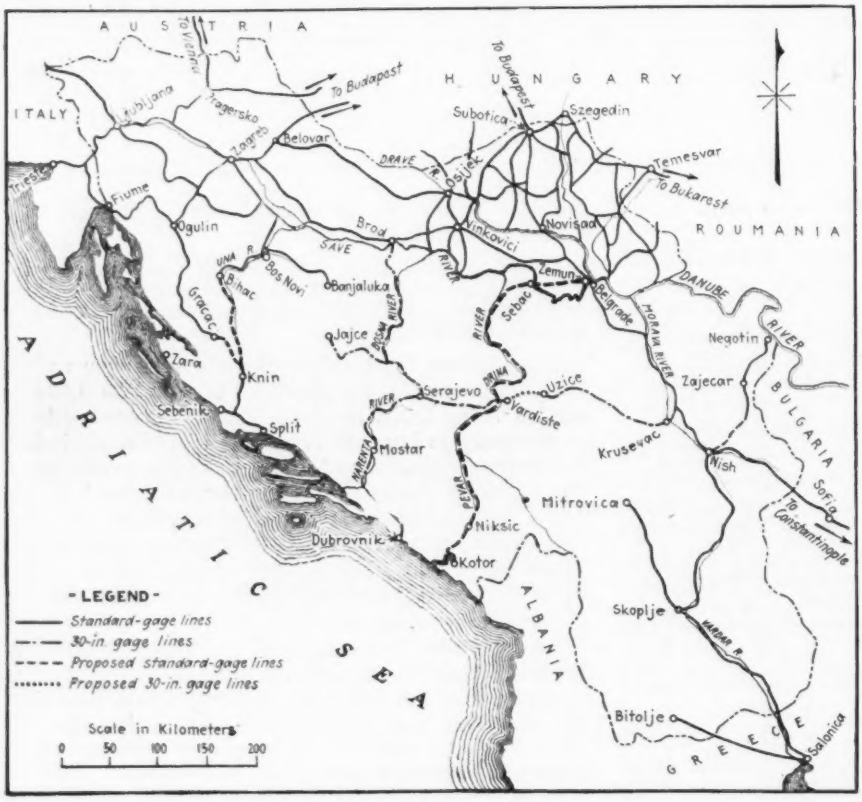


FIG. 1—RAILROAD MAP OF JUGO-SLAVIA

The main heavy-traffic roads of the Dual Empire radiated from Vienna and Budapest for strategic reasons and also in order to force traffic through these two cities. These lines were supplemented by others of less capacity parallel to the Imperial frontiers. In the details of location military requirements always governed and economy of construction or operation was secondary. The end of the war found all rolling and shop equipment in bad condition. Each country held all equipment within its borders with the result that the number of types in any given country was excessive. In Jugo-Slavia there were over 100 types of locomotives in a total of about 1,500.

The conditions in the kingdom of the Serbs, Croats and Slovenes, known in the United States as "Jugo-Slavia," are of especial interest because rehabilitation and the construction of new lines are being financed by an American syndicate headed by Blair & Co. The first installment of this loan is $25,000,000, of which $10,000,000 is to be expended for rehabilitation, and an equal amount for new construction. William B. Poland, assisted by J. H. Porter, are engineers for Blair & Co. in Belgrade.

Jugo-Slavia is made up of the former independent kingdoms of Serbia and Montenegro with a number of the southern provinces of the former Austro-Hungarian Empire. The railway system of which the principal lines are shown on the map, consists of 5,647 km. of standard and 2,020 km. of narrow-gage lines, of which 197 km. are 60-cm. and the remainder 76-cm. gage. These lines are government owned except 819 km. of standard gage in the western part of the country owned by the Southern Railway Co.

The railroads in the old kingdom of Serbia were probably more completely destroyed than those in any of the other war-torn countries. The rebuilding of the structures in the face of an almost complete absence of resources presents one of the best examples of engineering efficiency and resource conceivable. This work was a monument to the ability of the profession, and one for which the Serbian engineers deserve the highest praise.

The system of Bosnia-Herzegovina is all 76-cm. gage in a very mountainous country. This system radiates from Serajevo, reaches the Adriatic at Dubrovnik (Ragusa) and connects with the standard gage at Brod. Serajevo, the capital of Bosnia, is located in a basin at the head of the Bosnia River. (Fig. 2.) The grades of all lines except that which follows the Bosnia River to the north, are heavy. Those of the line to Dubrovnik are the heaviest; 6 per cent for 18 km. on which the Abt rack system is used.

The primary need of the kingdom is adequate facilities for foreign trade. Supplying this need involves both port and railroad construction, the construction of adequate terminal facilities at several junction points and the changing from 76-cm. to normal gage of some of the narrow-gage lines. There are available two ports under foreign flags, which are already connected to the interior by railroads, Salonica and Fiume. Salonica is economically available only as the outlet for the southern portion of old Serbia, and Fiume will properly serve only the extreme western portion of the kingdom. The 2.5 per cent grade on the railroad out of Fiume is a great handicap as is the small size of the port itself.

The two ports, Split (Spalato) and Kotor (Cattaro) under the Jugo-Slav flag, which as yet have no rail

FIG. 2—CORNER OF THE MARKET PLACE IN SERAJEVO

connections, are fortunately much better located to serve the whole country than Fiume or Salonica and have better natural harbors. Split has a small harbor with few facilities but on the opposite side of the point on which the present city stands there is a large well-protected bay with ample area and deep water. The Roman Emperor Diocletian was born in Split and his palace now houses about 3,000 of the inhabitants of the city. There are three very large cement mills on the bay, operated by hydro-electric power. There is sufficient area for the construction of ample rail terminals near the Roman city of Salona, many of whose walls are still standing.

Shortly before the war, railroads to connect Split with the interior were commenced. The line connecting the two ports of Sebenik and Split and extending toward the interior as far as Knin were completed, and the so-called "Lika" line is now completed to Gracac as well as about 50 per cent of the grading between Gracac and Knin, a distance of about 50 km. This line is badly located, has 1.8 per cent uncompensated grades and heavy curvature. The Una River line was completed a short distance beyond Bos-Novi leaving 120 km. yet to build to a connection with the Lika line to Knin. This line will have only a short section of 1.8 per cent summit grade with a ruling grade of less than 1 per cent on the rest of the line. Undoubtedly the completion of this system and the construction of the necessary port facilities at Split will be one of the first projects undertaken by the existing syndicate.

The development of Split will not furnish sufficient facilities, and port and railroad construction to develop the Bay of Kotor will undoubtedly follow. Kotor is one of the best and most thoroughly protected harbors

FIG. 3—AN IMPORTANT STREET CORNER IN BELGRADE

in Europe. It has a large area, deep water, is thoroughly protected against high winds by the high mountains surrounding it, and is not accessible to artillery fire from the sea. It was the principal sea-plane and submarine base for the Austrian navy during the World War.

The railroad to serve this port will be entirely new and will tap a virgin country. It will start from Zemun across the Save from Belgrade and follow the Save, Drina and Pevar Rivers to Niksic in Montenegro whence it will follow the sides of the mountains around the Bay of Kotor to a point on the south side of the central section of the bay where there is ample area suitable for terminal construction. The length of this line will be about 440 km. of which about half will be very light construction and the other half fairly heavy mountain work. There will be one tunnel, 10 km. in length.

The territory tributary to the lines to Split is a fairly productive agricultural country, has large deposits of iron and coal, large areas of good timber and in the vicinity of Zagreb some well-developed industries. The Kotor line will give an outlet for some of the best

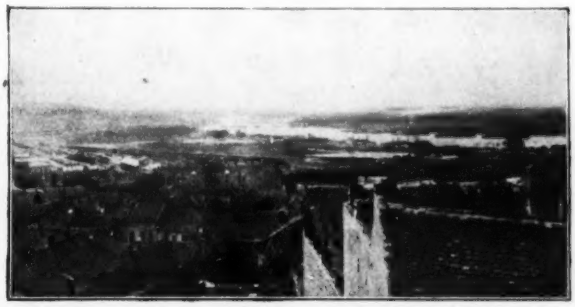


FIG. 4—LOOKING UP THE SAVE RIVER FROM BELGRADE
The bridge at this place was destroyed three times during the World War.

agricultural land in Europe and make it possible to open many important deposits of coal, copper, lead, antimony and salt in Serbia and Bosnia.

Belgrade-Zemun and Zagreb will be the most important transportation centers and their terminals require great expansion. Belgrade is built on a promontory at the junction of the Save and Danube Rivers. It is a well built city of about 130,000 inhabitants. (Fig. 3.) There is insufficient area for the necessary terminal expansion and because of this as well as the fact that the traffic requirements also favor it, the expansion will be made at Zemun on the opposite side of the Save. The two cities are connected by a bridge which was blown up three times during the war (Fig. 4), and are from a traffic standpoint, practically one city. Zagreb was an important terminal before the war, but even with the present difficulties of transportation, the traffic on the state railway system has increased from 45,000 cars in 1913 to 72,600 in 1919, and it is estimated that capacity for 100 per cent greater traffic must be provided.

The narrow-gage line from Krusevac to Uzice passes through a zone which contains oil and many important mineral deposits and produces a large agricultural surplus. This line can easily be made a normal gage (Figs. 5, 6, 7) and will serve as a connection between the new Drina River line to Kotor and the existing line between Belgrade and Nish.

FIG. 5—ON THE SERBIAN NARROW-GAGE

FIG. 6—AT BANJASKA BANJA
On the narrow-gage railway, 30 miles from Krusevac.

FIG. 7—AT IZVOR, ON THE SERBIAN NARROW-GAGE

There is abundant water power in a large part of Serbia, Bosnia and Dalmatia. The only large developments are at Jajce where there is a carbide factory having a plant which runs about a 30-m. head in two penstocks about 60 cm. in diameter, and the still larger plant operated in connection with the cement mills at Split.

There is no country in Europe, with the exception of Russia, which has so great undeveloped resources as Jugo-Slavia. The people are peaceable and hard working and now that American capital is becoming interested it is a country which deserves and will demand the attention of American engineers.

Street Sprinkling in Peking, China

In Peking, China, the sprinkling of the streets is accomplished by the primitive method of filling with water rather closely woven willow baskets, attached to long poles, and shaking the baskets over the street.

Improved Daylight Factory Lighting

BY G. P. RICHARDSON
Detroit Steel Products Co., Detroit, Mich.

HOW to improve the daylight lighting for shop work was a problem in utilizing an old five-story building to provide additional manufacturing capacity for the automobile division of the Studebaker Corporation at South Bend, Ind. The building is 165 x 278 ft., of timber beam and girder mill-type construction, with wood columns, plank floors and brick walls.

FIG. 1. OLD WINDOWS GAVE POOR LIGHT DISTRIBUTION

In the original construction each 19½-ft. longitudinal bay had two window openings 6 ft. wide, with box frames, sliding sash, and arched top 18 in. below the bottom of the floors. Small brick piers carrying no load from the floors were built between the windows. With this arrangement for a building 165 ft. wide the center part was very poorly lighted.

To provide more light on the first and second stories, the old wood sash and small brick piers in the long sides of the building were removed and the openings were carried up to the underside of the next floor, steel lintels being installed to carry the brick curtain walls between the main piers. Steel-frame windows were

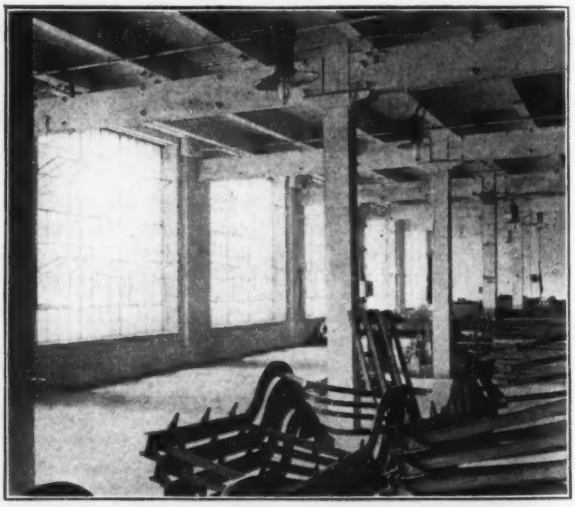


FIG. 2. EFFECTIVE LIGHTING WITH NEW STEEL SASH

then placed in the new openings and without weakening the building the glass area was increased 83 per cent. This alteration was planned by Lockwood, Greene & Co., Boston and Chicago, engineers for the Studebaker Corp., and was carried out without interference with manufacture by the H. G. Christman Co., South Bend.

Dry Fill and Hydraulic Sluice Methods On Same Dam

Different Methods Employed on Opposite Sides of Thin Concrete Core Wall in Earth Dam on Hetch Hetchy Project—Core Wall Has Contraction Joints in Length

PRIEST DAM is being built to provide a forebay for the Moccasin Creek power plant which is the first large power unit to be installed on the Hetch Hetchy water and power project now being carried out by the city of San Francisco. The dam will have a maximum height of 145 ft. and will be about 1,000 ft. long on the crest, developing a storage of 2,500 acre-ft. The lower end of the 18-mile section of the Hetch Hetchy tunnel will be submerged in the reservoir formed by this dam and the penstocks of the Moccasin Creek plant will be supplied by a tunnel leaving the reservoir several hundred feet upstream from the dam.

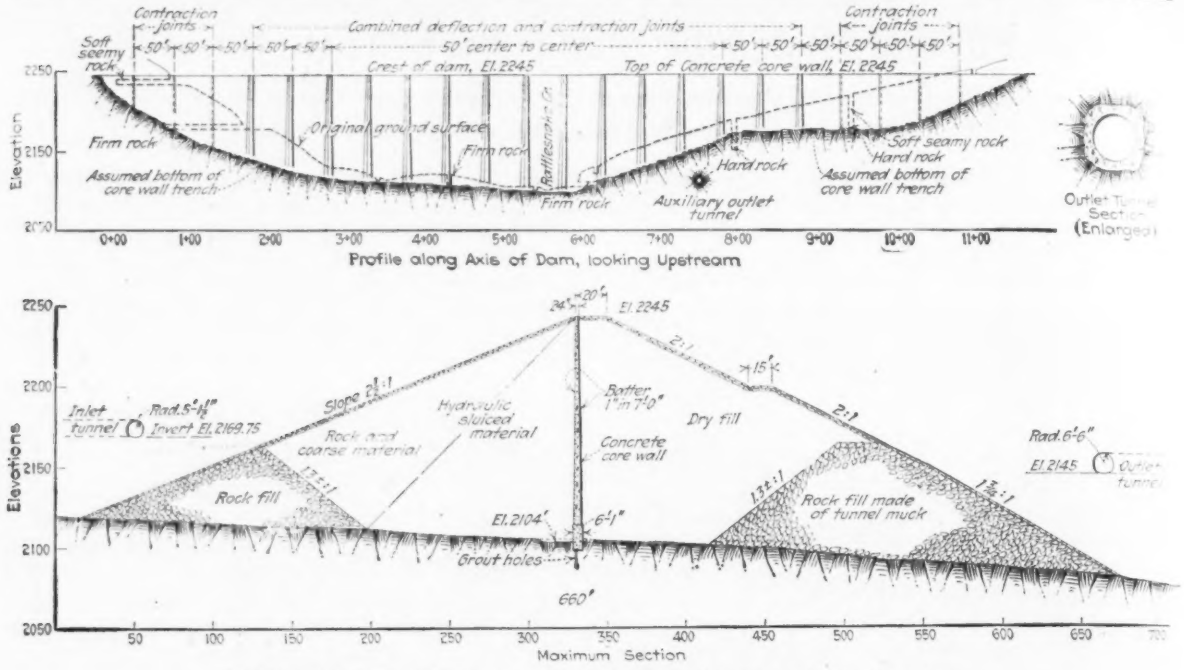
VIEW OF PRIEST DAM SHOWING TWO CONSTRUCTION METHODS

At extreme left, track to first borrow pit on far side of dam. Hydraulic monitor for washing fines from dry fill against core wall. First bents for trestle from next borrow pit level appear at far end of dry fill. First sluicing pit in center background. Pumphouse in extreme right foreground.

Features of the structure are (1) the design of the concrete core wall which is provided with numerous joints to permit flexure without cracking should material in the fill settle unequally and (2) the adoption of different methods for placing material on the up- and the downstream sides of this core wall. By the use of the two methods of handling material a suitable embankment which will allow drainage if necessary, is secured on the downstream side at low cost while a well-compacted impervious fill will be made on the upstream side. The work was begun in October, 1921, and is to be completed in 700 days. A total of about 800,000 cu.yd. of material will be placed in the structure. Both up- and downstream slopes are to be faced with riprap 2 ft. thick on downstream face, with variable thickness on the upstream face as follows: 5 ft. thick below El. 2,150, 3 ft. thick from El. 2,150 to 2,200, and 2 ft. thick above El. 2,200. A concrete lined spillway with a capacity of 1,000 sec.-ft. will be provided around the east end of the dam. The main channel of this spillway is 4x20 ft. in cross-section, the entrance end, however is a tapered section on a variable grade in order to accelerate the water to the required velocity. This is considered ample as there is only a very small drainage area in the natural basin above the dam and water will rarely, if ever, pass over the spillway. The only other waterway in the dam is the scouring tunnel around the east end which was driven on a 2.222 per cent grade and taps the reservoir at the lower level. This tunnel is 6 ft. in diameter inside a 12-in. concrete lining and is 900 ft. long. Control of the tunnel is to be provided by two 30-in. valves at the upper end and operated by hand equipment in a concrete tower.

Foundation for the core wall was poured in a trench excavated into rock. Holes were drilled in the bottom of the trench at intervals of 5 ft. into which grout was forced through pipes driven into the drill holes and carried up through the concrete. The core wall is being carried up in 16-ft. lifts, just fast enough to keep well ahead of the fill. As shown in the accompanying drawing, the core wall has horizontal joints every 16 ft. and vertical joints every 50 ft., these joints having adjacent faces tarred to prevent bonding and No. 10 gage copper strips to keep them water tight.

As a means of steadying and strengthening the wall against unbalanced pressure that might occur during



ELEVATION OF PRIEST DAM AND CROSS-SECTION AT MAXIMUM HEIGHT

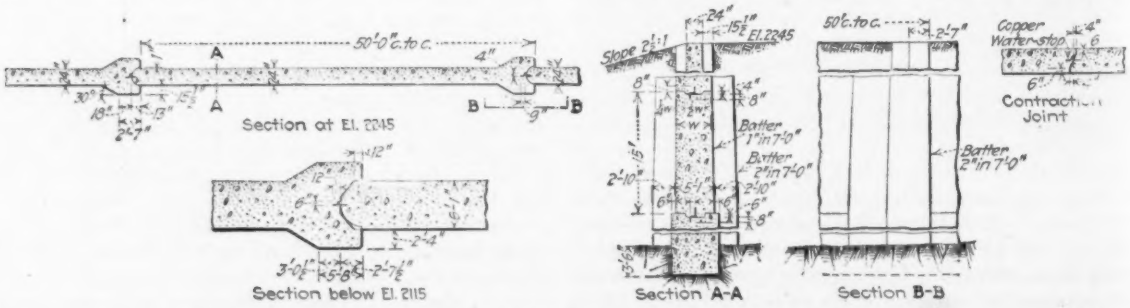
construction and before the two fills have settled, the wall is tied to deadmen in the fills on both up- and downstream sides by cables. The cables are attached to 1½-in. eyebolts set in the concrete 16 ft. apart vertically and 50 ft. apart horizontally.

A means of carrying up this core wall without staging on either side was devised by combining the staging with concrete forms and supporting them on completed sections of the work. The core wall is poured from the east end, where the concrete mixer is located, and whence the work progresses toward the west end. By the time the full length of each 16-ft. lift is completed the forms first placed are raised and the process is repeated. The bents or frames of 6x6-in. timbers that carry the track for concrete cars are placed 9 ft. 9 in. apart and are attached to the concrete by ¾-in. bolts which extend entirely through the core wall and project on each side. These bolts are left in the concrete when the bents are raised. Between the timber bents built-up panels, 4 x 9 ft. 3 in. in size, are used, held in place by ordinary tie wiring. Planks carried at two levels alongside these panels are useful as staging from which carpenters can work on the forms. Forms for the enlarged sections that occur every 50 ft. at vertical joints are not alike in successive tiers and have to be built up independently of the standard form.

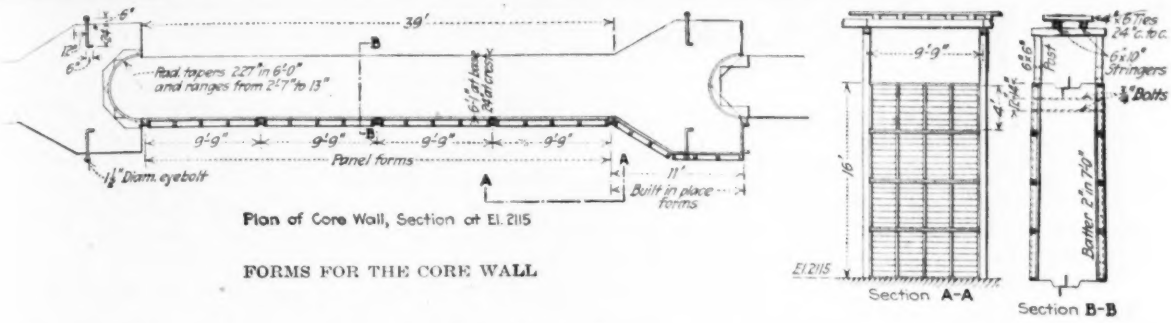
Concrete for the core wall is supplied by a mixing plant close to the core wall trench on the east abutment. At this point the hillside has a uniform slope and as the wall is carried up, the mixing plant will be moved up the hill; the plant was built up on skids in three sections to facilitate the moves, of which there will be three. A 1:2:4 mix is used in the core wall and also in the bypass tunnel lining which was supplied from the same mixing plant. Cement, sand and crushed rock for the concrete are delivered to the mixer by means of an incline from bins on the hillside above the dam level.

Both the dry fill and hydraulic sluice material is being taken entirely from the western bank. The sluicing pits are upstream from the dam and the borrow pits in which the steam shovel works are on the downstream side. When the present work started some 80,000 cu.yd. of rock was already in place on the downstream toe of the dam, this material having been dumped within predetermined limits as it was mucked from the 18-mi. tunnel whose portal is only a few hundred feet distant. The steam shovel began work at a level 65 ft. above the lowest point in the dam and by dumping on the upstream edge of the existing tunnel dump widened it until the upper edge of the fill came close to the core wall.

A small hydraulic monitor is used for washing down fine material from the upper face of this dry fill whence



CORE WALL SECTION SHOWING ARRANGEMENT OF CONTRACTION JOINTS



FORMS FOR THE CORE WALL

it lodges the fines against the downstream face of the core wall in the form of well compacted layers. This feature of the construction program is very successful, the fine material is readily washed out by a jet directed downward from the top of the fill and the water remains in a pool against the core wall long enough for the material in suspension to deposit. That the downstream fill is sufficiently porous is shown by the fact that this sluicing water readily seeps through to the downstream toe whence it may be caught in the natural stream bed and used again, should any water shortage develop.

With the first level of the dry fill completed, the plan is to have the steam shovel make an inclined bench cut up which it can move to a new borrow pit level 35 ft. higher. From this new level tracks will be carried along the sidehill and thence at the same level on a trestle 35 ft. high entirely across the dam and supported on the portion of the dry fill already placed. When the material dumped from this trestle reaches track height the track will be moved over onto the fill and by dumping along the upper edge, the fill will be widened until the toe of the slope again reaches the core wall. Sluicing down the upper face of this fill will be continued and as the fines are washed down the level of the deposits against the downstream face of the core wall will be built up.

This program will be continued to the top of the dam, the fill on the downstream side being regulated so as to be equal to or slightly ahead of the fill on the upstream side of the core wall, which will always be saturated. Four levels for the steam shovel work and the three trestles, the last two trestles each being 22½ ft. high, will be required to carry the dry fill up to the prescribed height.

Water for sluicing operations is pumped from a pool maintained above the dam and is delivered through a 14-in. wood stave pipe line tapped by 12-in. laterals. The main line extends about 1,000 ft. from the pump house to a point on the hillside above the dam where five laterals are taken off at suitable levels for sluicing material down a 5 per cent grade to five successive trestle heights on the dam. The sluicing water is delivered by a pump which is direct-connected to a 500-hp., 440-volt motor. The pump, which was built especially for this work, has only one stage and operates at 1,800 r.p.m. with a rated delivery of 4,250 gal. per min. under a head of 350 ft. For auxiliary sluicing and other water supplies on the work, a smaller pumping unit in the same plant delivers 600 gal. per min. under a 250-ft. head.

From the sluicing pits material is carried in flumes to a trestle along the upstream face of the dam whence distribution is effected by laterals as desired. A crew of about six men with shovels is required to keep the upstream face of the fill shaped up to the desired slope. These men stake a 2x12-in. plank on edge to mark the limit of each successive fill in accordance with the slope predetermined by surveys. When sluiced material has piled up against the plank to the desired height, the delivery is continued through some other lateral while the men shovel material from the inside over the plank to smooth off the outer slope. The plank is then raised 1 ft. and moved back from the slope to carry up the next step.

The dam was designed under the direction of M. M. O'Shaughnessy, city engineer of San Francisco. W. A. Kraner designed the construction layout and is supervising construction for the city.

Seepage from Earth Canals in Texas

By W. F. Heath
San Benito, Tex.

TESTS for seepage and evaporation in one of the canals of the San Benito (Texas) Irrigation District indicate 92 per cent of the total loss is seepage and 8 per cent evaporation. Spread over the whole district these losses amount to nearly 1 acre-ft. per acre over the total 60,000 acres of irrigable land in the project, half of which is in cultivation. The cost of pumping and delivering this extra water is small compared with the damage done to the land, a large portion of which has become alkaline and unfit for cultivation. Even land still in brush has become "salted."

Two methods of preventing seepage are suggested; lining the canals and constructing drains on each side of the canals. The first is expensive but would reduce the seepage to a minimum; the second would not reduce the seepage but would minimize its harmful effects.

From the logs of many borings the soil is found to be deposited with a top layer of silt, 2 to 5 ft. deep, a second layer of clay, 4 to 9 ft. deep and a third layer of quicksand of indefinite depth. It has been noted that seepage water travels on top of the clay stratum gradually working to the surface with its load of dissolved alkali, most of which is common salt.

In canals in which the borrow pits extend down into the clay and are connected with main drains very little trouble is experienced from seepage, but for many of the older laterals the earth to make the levees was taken from the center and no borrow pits were made. The harmful effects of seepage are more apparent in land adjoining these laterals.

In the design and building of earth canals with the idea of making the effects of seepage the least harmful in this district the wetted perimeter should be made as small as possible and drains having a good grade and connecting with main drain ditches should be built each side of the lateral, extending well down into the clay.

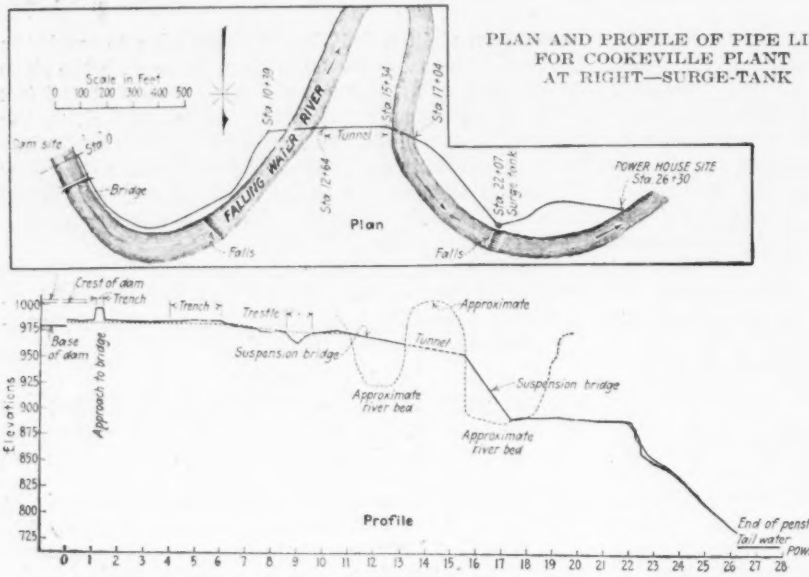
Small Municipal Hydro-Electric Plant in Tennessee

Cookeville Installs 450 Kw. Station With Concrete Dam and Long Wood Pipe Line Crossing River on Suspension Bridges

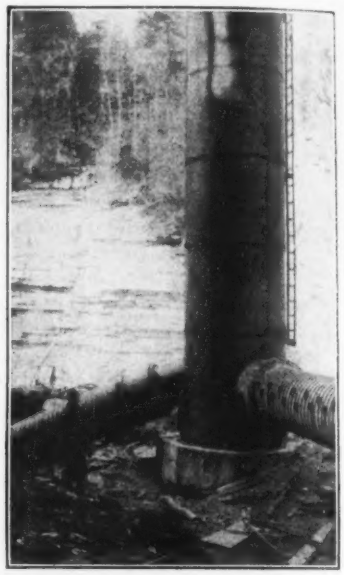
THE city of Cookeville, Tenn., having a population of less than 3,000, has recently completed the building of a hydro-electric plant embodying some unusual features. As an example of a small waterpower development, designed and built along modern lines, it is of more than local interest.

The plant is located on Falling Water River, a creek having a minimum discharge of but 12 sec.-ft. Within a distance of one mile, the stream has a fall of approximately 200 ft. In making the preliminary study of the project, it was found that by twice crossing the stream on suspension bridges, and tunneling an intervening bluff, the length of the penstock could be reduced to half a mile.

The penstock is a 30-in. wood-stave pipe, built by the Continental Pipe Co., of Douglas fir, and its length is 2,631 ft. The head works consist of a dam, 26 ft. high and 310 ft. long, approximately one-half being concrete, of gravity section, and one-half of earth, with concrete core-wall. The dam creates a very valuable storage, being located at the head of the series of falls which intervene between dam and power house, and causing back-water three miles long.



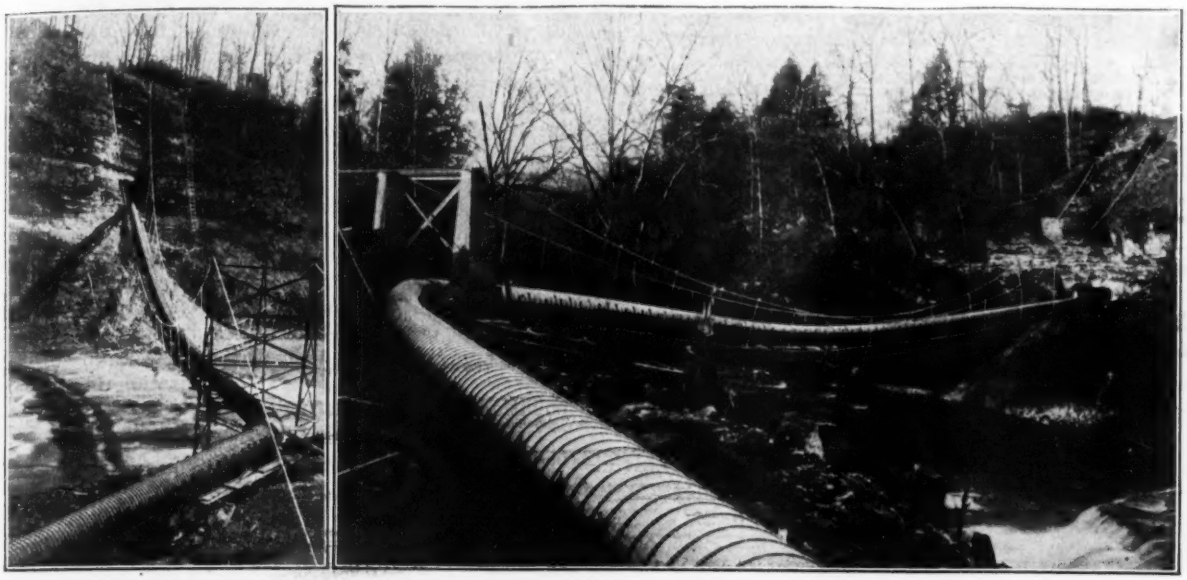
PLAN AND PROFILE OF PIPE LINE FOR COOKEVILLE PLANT AT RIGHT—SURGE-TANK



EARTH AND CONCRETE DAM, 26 FT. HIGH, 310 FT. LONG

From the dam, the penstock is laid (on concrete cradles where firm foundation was not available) along one bank of the stream to a point about 1,000 ft. from the dam, where a 45 deg. turn leads onto the first suspension bridge. The span of this bridge is 238 ft., and leads directly into the tunnel. The tunnel, driven on a 10 per cent grade, and terminating in a 40-deg. horizontal curve, is 285 ft. long, driven through solid limestone rock. From the lower portal, the penstock enters immediately upon the lower suspension bridge, of which the span is 167 ft. long. On this bridge the pipe makes a vertical reverse-curve, entering nearly horizontally, and leaving horizontally, 40 ft. lower. The bridges carry a load of 400 lb. per lin.ft. The cables were furnished by the A. Leschen & Sons Rope Co. The design of the bridges is quite simple as shown in the views. The two main cables are 1⅛ in. diam. and the suspender rods are ¾-in. rods, with channel-iron floor beams carrying timber stringers.

From the lower suspension bridge for a distance of another 500 ft., the pipe follows the bank of the river, here reaching the brink of Burgess Falls, which has a sheer drop of 115 ft. On the brink, the penstock enters a steel surge tank, 6 ft. in diameter, and 120 ft. high, which is self-supporting. The penstock, leaving the surge-tank, plunges at an angle of about 35 deg. down the gorge to the power house, 550 ft. beyond, and 120 ft. below the base of the surge-tank. For a part of this



THE TWO SUSPENSION BRIDGES WHICH CARRY THE PIPE LINE

The lower bridge is shown at the left, the upper bridge at the right. These bridges are supported at one end by tower and at other by cable entering rock face. One 167-ft. span bridge has steel tower; other bridge, with 238-ft. span, has single concrete tower. From both bridges pipe enters tunnel in rock face of river bluff.

distance the penstock is supported in stirrups, hung by cables from above, on the side of the gorge.

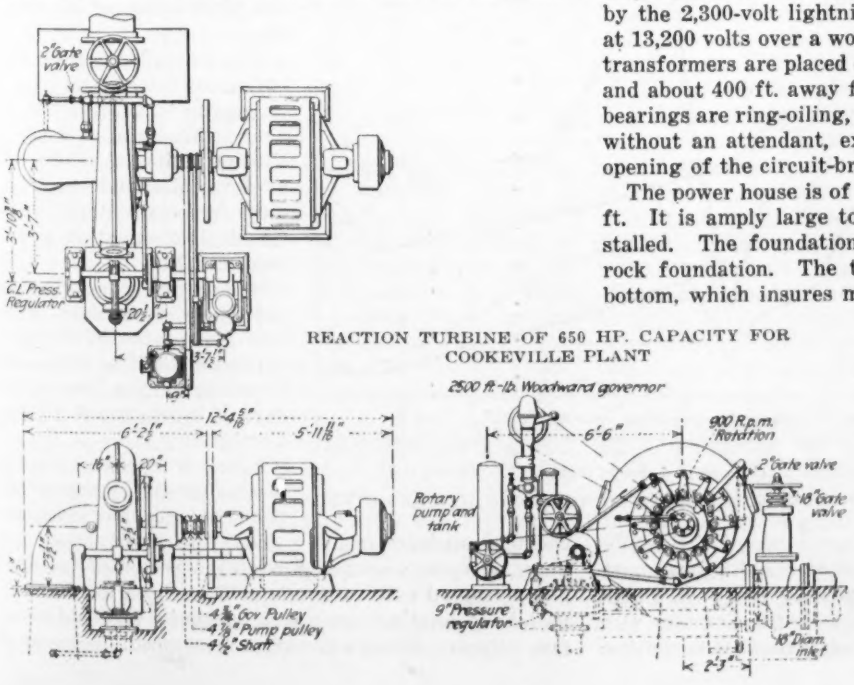
The tunnel was made just as small as it was possible to drive it. It is only 6 ft. wide, and for most of its length, less than 6 ft. high. It is in a hard limestone formation, and no shoring was needed. The wood-stave pipe is continuous, and so was built in place. Although the space in the tunnel is very cramped, there was no complaint from the workmen. There is barely room for one to edge his way through the tunnel, between the pipe and the walls, and he cannot walk through erect.

The hydrostatic head on the plant is 230 ft. The turbine is a horizontal, scroll-case machine, built by the Wellman-Seaver-Morgan Co., and it has the distinction of being the smallest wheel ever built by that concern. The runner is of bronze, 19 in. in diameter. The scroll-case is fitted with a relief valve, actuated by the hydraulic governor, both relief valve and governor being built by the Woodward Governor Co. Under the working head of 220 ft., the turbine develops approximately 650 hp. The relief valve, together with the surge-tank insure exceedingly close speed regulation—regulation not attained by many a hydro-electric plant of much larger output.

The plant is not automatic, but requires an attendant. Current is generated at 2,300 volts, and the windings are protected from lightning which might conceivably strike between the generator and the transformers by the 2,300-volt lightning arresters. Transmission is at 13,200 volts over a wood pole line 12 miles long. The transformers are placed on top of the cliff, 300 ft. above, and about 400 ft. away from the power house. Since all bearings are ring-oiling, the plant could very well be run without an attendant, except for the possibility of the opening of the circuit-breaker.

The power house is of steel and measures only 18 x 20 ft. It is amply large to house the single unit now installed. The foundation is of solid concrete, on solid rock foundation. The tailrace has a smooth concrete bottom, which insures minimum tailrace loss of power. There is not a stick of wood about the power house, as walls and roof are of steel, and the windows are steel sash.

The plant is designed to permit the future installation of a second unit, when the demand for power shall require. However, when it is considered that the present plant displaces a steam-electric plant of 75-kw. capacity, a 450-kw. plant looks to the people of Cookeville like an exceedingly dignified hydro-



REACTION TURBINE OF 650 HP. CAPACITY FOR COOKEVILLE PLANT

electric development! The total cost of the plant was about $110,000, divided as follows:

Cost of power site and reservoir area	$25,000
Machinery, including turbine and governor, generator, Tirrill regulator and switchboard	20,000
Twelve-mile transmission line, including transformers and lightning arresters	30,000
Construction of dam, pipe line, tunnel, suspension bridges, surge-tank, power house, valves, sluice gate and trash-rack, and engineering service	35,000

The plant was designed by J. A. Switzer, and built under his supervision. On his advice, all bids for the building of the plant were rejected, and the plant was built on force-account, under the superintendence of T. O. Hudson. The total cost of the plant was approximately 15 per cent less than the lowest bid received.

Studies of Natural Purification on the Illinois River

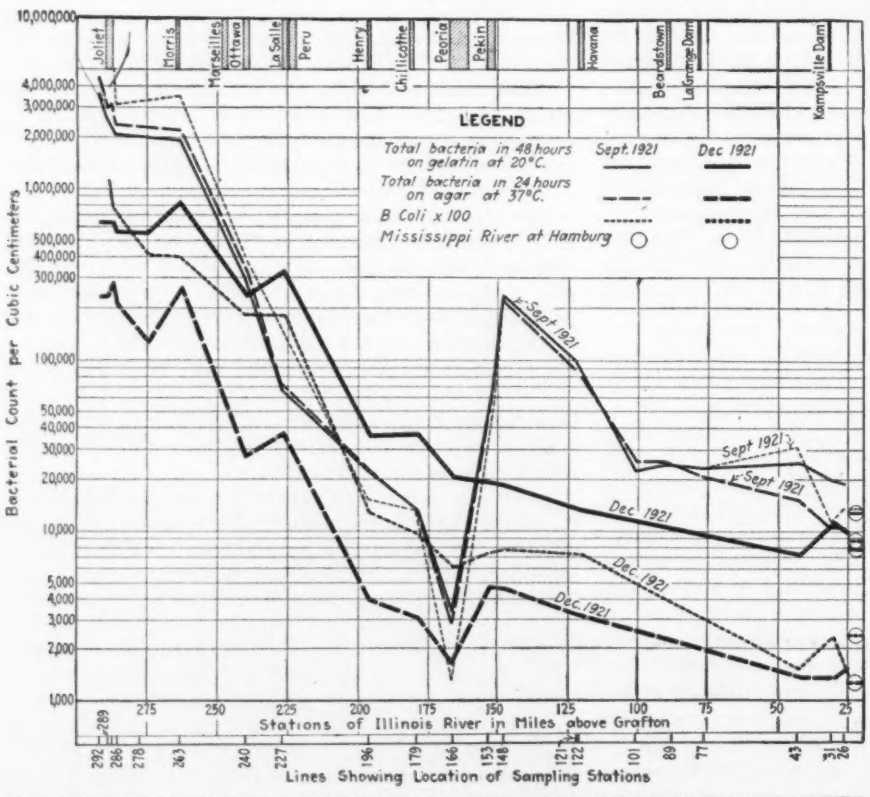
Public Health Service and Chicago Sanitary District Maintain Joint Laboratory—Summer Death Rate of Germs High

By J. K. Hoskins
Sanitary Engineer, U. S. Public Health Service

BACTERIAL pollution of the Illinois River and the Mississippi River at the mouth of the former are approximately equal. Upstream on the Illinois the winter and summer variations of pollution as measured by bacterial counts, dissolved oxygen and oxygen consumed are decidedly marked. These are some of the results coming out of the studies of pollution and natural purification of the Illinois River made by the U. S. Public Health Service in co-operation with the Sanitary District of Chicago. For such study, which is a continuance of the work done on the Ohio River, the Illinois River affords exceptional advantages by reason of its considerable length—nearly 300 miles—the gross pollution in its upper reaches immediately below the outlet of the Chicago Drainage Canal and its freedom from further considerable pollution except in the vicinity of Peoria, thus presenting long stretches in which the operation of natural agencies of purification may be observed. A further consideration of great importance is that for some years the Sanitary District of Chicago has carried on most thorough studies of the amount and character of the wastes discharged into the Drainage Canal and is thus enabled to furnish basic data which must otherwise be collected at great expense.

The study of the Illinois River was organized as a separate unit of the general organization for stream pollution investigations under the division of scientific research of the Public Health Service with an advisory board consisting of three consultants; Langdon Pearse, sanitary engineer of the Sanitary District of Chicago, Dr. E. O. Jordan, professor of bacteriology of the University of Chicago, and Dr. Stephen A. Forbes, chief of the State Natural History Survey of Illinois, and professor emeritus of University of Illinois, representing the fields of sanitary engineering, bacteriology and fresh water biology, respectively.

Headquarters and a main laboratory for the field studies were established early in 1921 at Peoria, located midway between the headwaters and mouth of the river. Three branch laboratories were equipped at Joliet, Beardstown and Kampsville, points to which samples can be delivered promptly from practically any section of the river. These laboratories, with the exception of the one at Beardstown, were operated for a full year, to record the effect of seasonal and other changes that might modify the phenomena of purification.



COMPARISON OF SUMMER AND WINTER BACTERIAL CONDITION IN ILLINOIS RIVER

The bacteriological examination comprised total counts on gelatin at 20 deg. and on agar at 37 deg. C. and quantitative estimates of B. coli by fermentation tests. The most important item in the chemical examination is the determination of the dissolved oxygen present in each sample by immediate titration and of the biochemical oxygen demand as calculated from the oxygen loss in five days of incubation at 20 deg. Centigrade.

Since it appears that in studies of this character the value of frequent elaborate chemical analyses is not sufficient to justify their expense, composite samples covering a period of ten days and preserved with sulphuric acid are used for determinations of total nitrogen, free ammonia, Kjeldahl nitrogen, nitrogen oxides and oxygen consumed. Samples of

bottom sediment and of water from the surface and from mid-depth are collected regularly from selected stations for macroscopic and microscopic biological examinations, involving the measurement and identification of plankton forms.

In addition to the laboratory field work, supplementary observations of stream flow have been made in cooperation with the U. S. Geological Survey to determine the daily flow of the Illinois and all important tributaries. The times of flow from point to point throughout the river were calculated from stream flow data and cross-sectional areas taken from the river bed contour maps of the U. S. Army Engineering Corps.

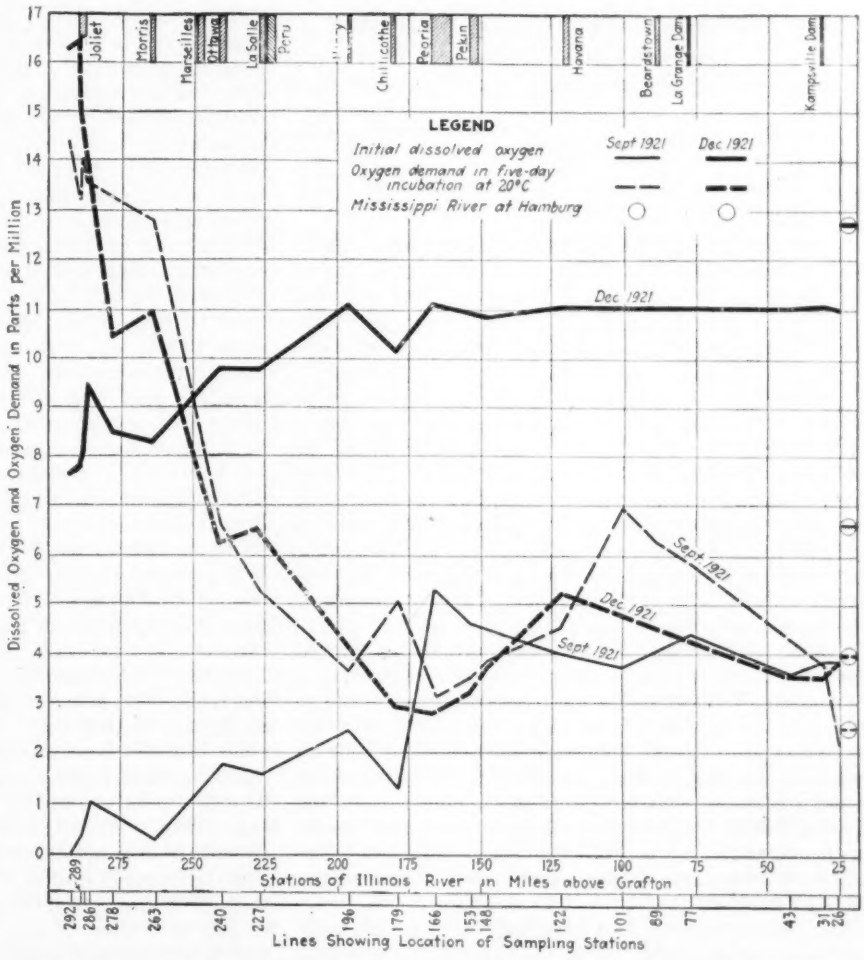
During the summer months the total bacterial counts on agar at 37 deg. (24 hours) immediately below the drainage canal ranged from 2,000,000 to 5,000,000 per cubic centimeter, whereas in the winter months they have ranged from 100,000 to 300,000 (monthly averages). Since the volume of the Illinois River at stations 292-286 (see chart) is nearly constant, this indicates a wide seasonal variation in the total bacterial content of the sewage of the Sanitary District. Similar seasonal variations are noted in the gelatin count and B. coli. This is in accordance with observations at Cincinnati and Louisville on the Ohio River.

During the summer months the 20-deg. gelatin and the 37-deg. agar counts throughout the river are approximately equal, but with the onset of winter they diverge, the agar counts becoming much smaller than the gelatin counts. This likewise is in accordance with observations on the Ohio River.

The decrease in bacterial content from the outlet of the Drainage Canal to station 166, immediately above Peoria, is at all times very great, and is practically parallel in the agar count, the gelatin count and the B. coli. The decrease is absolutely and relatively much greater in summer than in winter. Dilution by tributaries is a very small factor in this decrease, which is largely due to death of the bacteria. From a bacteriological standpoint the river immediately above Peoria is not highly polluted—not more so than many streams draining rural sections.

The pollution resulting from wastes received in the Peoria district is very considerable in summer and the decrease below this point, though steady, is less rapid than in the upper half of the river.

In the upper river the oxygen demand greatly exceeds the supply as represented by the dissolved oxygen content, but in passing downstream from Joliet to Peoria the dissolved oxygen progressively increases and the biochemical oxygen demand decreases until the former exceeds the latter at a point well above Peoria, establishing an "oxygen balance." In summer the extent of oxygen recovery in passage through Peoria Lake (a large body of wide shallow water between stations 179 and 166) is remarkable; in winter it is less marked but noticeable. Below Peoria the oxygen demand increases gradually to a point just above Beardstown, with, in summer, a corresponding decrease in dissolved oxygen and a reversal of the oxygen balance. Although a distinctly measurable increase in oxygen demand below the urban district of Peoria is to be expected, this gradual increase over a distance of 50 miles is not yet fully explained.



OXYGEN CONTENT SEPTEMBER AND DECEMBER SHOWS RATE OF RECOVERY

As to observations so far made upon the Illinois River, it is impossible to correlate them in any fundamental way with observations on the Ohio, until they have been more thoroughly analyzed in relation to time-intervals, temperature and amounts of polluting wastes involved, but so far as may be judged at present the two sets of observations appear to check rather closely, justifying the expectation that, when taken together, they will give fundamental information regarding the laws of natural purification.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

For Students and Practicing Engineers

REVIEWED BY O. H. AMMANN
Assistant Chief Engineer, the North River Bridge Co., New York City

A PRACTICAL TREATISE ON SUSPENSION BRIDGES: Their Design, Construction and Erection—By D. B. Steinman, A.M., C.E., Ph.D.; Consulting Engineer; M. Am. Soc. C.E., M.A.R.E.A.; formerly Professor in charge of Civil and Mechanical Engineering at the College of the City of New York. With Appendix: Design Charts for Suspension Bridges. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Cloth; 6 x 9 in.; pp. 204; 62 line cuts and halftones. $4 net.

The suspension bridge has received rather scant treatment in modern bridge literature, although it is one of the oldest and in some respects most meritorious types of bridge. This is explained partly by the fact that since the passing of the suspension bridge era few engineers have had the opportunity to become thoroughly acquainted with it and partly because it presents more complex and changeable economical and structural problems than other types. The appropriate degree of rigidity and safety, the most suitable type and proportions of the stiffening system, wire cables versus chains, are questions which admit of a wide range of opinion and will probably always remain in dispute. The publication of Dr. Steinman's book should therefore be welcomed as helping to revive interest in a type worthy of greater appreciation.

In the short space of 200 pages the author has covered the technical part of the subject with fair completeness, by confining himself to the most essential theory and to a concise discussion of the most important elements and details of design and construction. The book is therefore a useful manual, especially for the student or young engineer, who however, as he advances in his studies, will be obliged to consult more specialized books on theory and construction. For this reason a bibliography on suspension bridges would have enhanced the value of this book.

The reviewer would also have liked to see the purely technical and scientific side of the subject supplemented by considerations on the aesthetic value and treatment of suspension bridges. Bridge engineering still is, and ought to be, regarded as an art in the loftiest sense of the word, and the suspension bridge in particular offers opportunities for giving expression to that higher phase of bridge designing. The student and young practicing bridge engineer, for whom this book is primarily intended, cannot be too early and too strongly inspired with the value and necessity of beauty in bridge building as a manifestation of the human soul; and unless he is so inspired, he will find himself sooner or later second to his more idealistic colleague, the architect.

The book is divided into four chapters, the first and largest of which is devoted to the theory of stresses. In so far as it applies to the system of a cable with independent stiffening truss, the theory is complete, concise and easy of application, besides being supplemented by useful charts (in an appendix) which reduce the work of calculating stresses to a minimum. The author has properly selected a combination of analytical formulas with graphic influence lines as the most convenient and lucid form for determining the stresses.

The suspended truss or braced cable is treated very scantily. It is true that its treatment is, in the main, identical with that of the rigid arch. There are, however, certain influences, such as the anchorage, backstays, and towers, which call for modifications. The inclusion of typical influence lines and simplified formulas for quick preliminary proportioning of the suspended truss would have placed that type on a par with the stiffened cable and would have added to the usefulness of the book by helping the student in the study and economic comparison of the two types.

The theory in this book has quite properly been confined to that of the rigid structure, and reference is made to various treatises on the more exact theory of the flexible structure. Emphasis should have been laid upon the fact that the latter theory is indispensable in the final proportioning of more important bridges, so as to impress upon the mind of the student that he has to deal with a flexible structure, and that economic advantages may be derived by treating it as such. The French engineers fully recognize this fact in the construction of their semi-rigid types.

The second chapter describes and compares the various types of suspension bridges, their economic proportions and important details of construction. It is clear, concise and up-to-date, but here again the author has foremost in his mind the cable with independent stiffening truss. The economic proportions given apply almost exclusively to that type. Moreover, it should be emphasized that the best proportions are dependent upon so many variable factors—such as character and ratio of live load, relative strength and cost of materials, stiffening system, width of bridge, etc.—that any values based on certain assumptions can be only roughly approximate and that careful studies are necesary in each particular case. For this reason the reviewer would have preferred to see an outline of the fundamental conditions upon which the economic proportions are evolved, rather than the dictum of rules of limited applicability.

The author places the economical span limit of the suspension bridge for highway purposes as low as 400 ft., and thereby accords it, with full justification, a much wider field of application than is generally conceded by bridge economists, who limit its usefulness to spans of 1,000 ft. and over.

The author discriminates against the eyebar chain by the assertion of unequal stress distribution in the individual bars, and the unqualified statement that measurements have revealed such inequality to the extent of from 40 to 200 per cent variation from the mean stress. Such conditions, if general, would condemn not only chains for suspension bridges, but eyebar chords in trusses as well, yet such chords are generally conceded to be the safest members in a bridge. It is unthinkable that, in a properly designed chain, made with modern accuracy in workmanship and uniformity of material, the variations in stress can exceed a small fraction of the total stress. Certainly the same degree of uniformity cannot be realized in wire cables.

The third chapter illustrates in a few examples the

practical application of the theory of the subject and is thus helpful to the student. Instead of proceeding on the basis of given proportions and sections, it might perhaps have been more instructive to illustrate the evolution of a design from its inception, the preliminary dispositions and necessary modifications.

The fourth chapter is devoted principally to the erection of wire cable bridges, for which experience has furnished ample material. Brief consideration is also given to the erection of eyebar chains, for which, however, no modern data are available, since the only two prominent modern chain bridges, built in Europe, have been erected on falsework, a procedure which destroys the economic advantage of the chain bridge.

The book is illustrated with photographs and line drawings of a number of suspension bridges, built and designed, and their principal details. It can be recommended as a textbook for students and also as a reference manual for practicing engineers, who will find in it much useful material made readily available.

Construction Costs

REVIEWED BY CHARLES F. DINGMAN
President, Palmer Construction Co., Palmer, Mass.

HANDBOOK OF CONSTRUCTION COST—By Halbert Powers Gillette, Editor *Engineering and Contracting*, M.Am.Soc.C.E., M.A.A.E. New York: McGraw-Hill Book Co. Flexible binding; 5 x 7 in.; pp. 1734; illustrated. $6.

To one who has made more or less constant use of Gillette's "Handbood of Cost Data" since its publication in 1910 his newer work, entitled "Handbook of Construction Cost," is indeed a valuable acquisition. The new work, as is stated in its preface, is in no sense a revision of the earlier book but may more properly be called an extension of it. So we now have available two rather crowded volumes of data covering almost every conceivable kind of a construction operation.

While several pages of instructions are given as to the methods to be used in taking off quantities from plans, and in computing the necessary amounts of materials and applying unit costs, the volume could hardly be used as a textbook by one who was attempting to learn the science of estimating. Its field of usefulness is rather in the hands of the experienced construction-estimator who can, from a study of the plans, specifications and site of the work, determine the extent of all necessary operations to complete a given project. Such a man should be able to select, from the numerous separate operations reported, and the wealth of detail given in almost every instance, the information which is applicable to his present problems and, by making proper adjustments, deduce estimated unit costs that should closely approximate final actual results.

Like the earlier book, this one does not attempt to formulate a series of tables covering the possible daily or hourly production per man, per team, or per machine, on various individual operations. In fact, it is doubtful if it would be practicable to do so in view of the wide range of work covered by its contents. It does, however, record, with complete descriptions of local conditions, information as to wage-rates and material prices, the actual results obtained upon hundreds of operations, ranging from unloading stone from cars to the complete replacement of an old pile trestle by a new plate-girder bridge, the work being done under traffic.

Perhaps the most valuable chapters in the book are the first two, Engineering Economics and Prices and Wages. If contractors could be induced to pay more attention to the study of such principles as are laid down in these two chapters it is not likely that *Engineering News-Record* would have been able to report, as it did early this year, that 40 per cent of all the construction companies in the country made no net profits in 1921. Of these chapters, the first points out the distinctions between different classes of estimates and the principles that should govern their preparation and also calls attention to many items that may seriously affect the total cost of doing work and that are, nevertheless, given scant attention or no attention at all in preparing estimates. The second chapter contains a mass of statistical information having a bearing on or relation to the rise and fall of material-prices and wage-rates, from which are deduced a wage-level formula and a price-level formula that make it possible to calculate, with reasonable accuracy, the money costs that will apply at a given time.

One criticism that might be made is that the type-size is much too small for convenient reference or for quick searches through the contents for particular information. This, however, seems unavoidable, since it would no longer be a "hand-book" if the same amount of matter were printed in very much larger type.

Odors and Their Travel Habits

REVIEWED BY ROBERT SPURR WESTON
Consulting Engineer, Boston, Mass.

SMELL, TASTE, AND ALLIED SENSES IN THE VERTEBRATES—By G. H. Parker, Sc.D., Professor of Zoology, Harvard University. [Series on Experimental Biology and General Physiology.] Philadelphia and London: J. B. Lippincott Co. Cloth; 5 x 8 in.; pp. 192; 37 illustrations. $2.50 net.

Prof. Parker discusses the nature of the organs of smell and taste, and their interrelation. He also gives the results of the latest researches into their anatomy and physiological functions. While the book has been written for readers interested in the biological sciences, it is of particular interest to engineers interested in odors and their travel habits.

There are two classes of substances which produce nasal stimulation, namely, irritants which act on the free ends of the trigeminal nerves and true odors which act on the terminals of the olfactory nerves. Certain irritating gases like ammonia have no true odor; a perfumed "smelling salt" may both irritate and produce an odor; such substances as the essential oils produce odors without irritation. Many tastes are really odors. Thus it is well known that vanilla cannot be "tasted" when the nose is held and the odoriferous particles are prevented from coming in contact with the olfactory region located behind the upper turbinated bone on each side of the nose, a region only about 6.2 sq.cm. in area. Many odors are not smelled because "sniffing" is usually necessary to bring the odoriferous particles in contact with the well-protected nerve ends On the other hand, certain substances may be detected when in extreme dilution,—as 0.00004 mg. of artificial musk in 1 liter of air.

Odors are classified by various systems of adjectives and their intensities as "detectable," "faint," "noticeable," "strong," and "very strong." It is interesting to note that the average concentration of various chemicals required to produce the effects described by these five adjectives vary in an almost true geometrical progression whose multiple is two.

Considerable attention is paid to the rapid fatigue of

the olfactories which explains why an all-night traveler in an emigrant coach smells nothing disagreeable in the morning and why new odors, like those produced by a newly-introduced industry, become less offensive as one becomes better acquainted with them.

Equally well treated is the sense of taste, although this sense is not particularly interesting to engineers. Each chapter contains a bibliography and the book should prove the best introduction to the study of these two senses.

General Relativity and the Engineer

REVIEWED BY GEORGE PAASWELL
Construction Engineer, New York City

THE THEORY OF GENERAL RELATIVITY AND GRAVITATION—Based on a Course of Lectures Delivered at the Conference on Recent Advances in Physics held at the University of Toronto in January, 1921. By Ludwik Silberstein, Ph.D. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 137. $2 net.

Dr. Silberstein's little book presents a mathematical treatment of relativity and is thus a difficult medium for the initial study of the theory. Taken in conjunction with, say, Eddington's "Space, Time and Gravitation," it furnishes a rather complete treatment of the subject. Though the engineer is not directly interested in theories of the structure of the universe, as is the scientist, he must find great profit in the development of a theory that promises a rational explanation of molecular action, since it is to the latter that one must look for the ultimate explanation of stress-strain relations.

Have Newtonian mechanics been superseded by Einsteinian mechanics? As a universally true interpretation of cosmic phenomena, yes. Several of the motions of the planetary system have never been explained by Newton; relativity has offered an explanation. Newtonian mechanics have failed to explain molecular phenomena; relativity mechanics give an explanation in complete harmony with experiment. In our everyday scientific work, on the other hand, Newton will continue to reign supreme, giving a plausible and completely satisfactory explanation of our ordinary static and dynamic phenomena. This apparent contradiction has a parallel in the fact that, despite the curvature of the earth, we are content in our local measurement to treat our restricted plot as a plane surface.

Briefly stated, relativity postulates that one cannot determine motion with reference to an absolute. Nature successfully thwarts our every attempt to determine such relative motion. All measuring or reference systems are thus purely relative and of equal value. Special or restricted relativity states simply that we cannot measure uniform motion with respect to the ether. This is a direct consequence of the failure of the Michelson-Morley experiment to determine such relative velocity. Since there must be some motion of the earth relative to the ether, the only explanation (Fitzgerald contraction) is that our measuring devices change in length with their relative motion.

To appreciate this strange effect, one must attempt a philosophic digression, and admit that our space and time distinctions are purely subjective. To a particle in motion there are four possible component directions, all of equal value, no one of which has any peculiar attribute. These are, forward and backward; up and down; before and after; right and left. Granting this four-co-ordinate location of a particle, we gravitate naturally to a conception (mathematically only) of four-dimensional space. Our senses cannot, of course, perceive such a space-time, but the Michelson-Morley experiment, as explained by the Fitzgerald contraction, shows that different sections of suggested space-time give different length measures, just as different sections of a three-dimensional body give varying cross-sections. In other words, our limited senses perceive this space-time in various three-dimensional sections only, and not as a four-dimensional entity. So much for the philosophy of relativity; the rest is essentially pure mathematics.

The fundamental postulates of the space-time are: (1) The interval of measurement between two events (corresponding to the distance between two points in our space) is the same no matter what reference system is used; this is merely an extension of our three-space invariant. (2) The velocity of light is the same to all observers, no matter in what system they are; the converse of this would permit the determination of the absolute motion. These two assumptions give sufficient data to build up the mathematics of this space. The Fitzgerald contraction leads to the Lorentz equations of transformation from one reference system to another. (When it is noted that the corrections to a length are of an order v^2/c^2 where v is the velocity of the moving body and c is that of light, it is seen how infinitesimal the correction is for the usual velocities other than electro-magnetic.) As a consequence of this relationship the four-dimensional space of relativity must satisfy conditions that do not make it a natural extension from our familiar Euclidean space but lead to what may be termed a hyperbolic space. Thus, in a natural extension of Euclidean space the element of length would be $ds^2 = dx^2 + dy^2 + dz^2 + dt^2$, while in the space required by relativity this length is given by an extension of the hyperbolic form $ds^2 = dt^2 - (dx^2 + dy^2 + dz^2)$.

General relativity removes the restriction of uniform motion and states that it is impossible to detect any form of motion, accelerated or uniform, with respect to an absolutely fixed reference frame. With the illustration of a falling elevator, one can substitute an accelerated reference system for the gravitational force. That is, in a field where there is no gravitation, one could, in a small portion of it, move a closed box along with an accelerated motion that would give every indication of gravity to those within it, and occupants of the box would have no way of distinguishing between true gravitation and the accelerated system. Gravitation effects are thus brought within the province of relativity by this principle of equivalence, and demonstrate that force fields themselves are but relative.

The fundamental postulates of general relativity are again: (1) The invariance of the space-time "interval" between two "events," and (2) the requirement that particles travel along a type of line called a geodesic, which is merely a line with the extended characteristic of three-dimensional space, "the shortest distance between two points." Thus the geodesic in a plane is a straight line; on a sphere, it is a great circle. These geodesics are themselves independent of any co-ordinate system. Such independent functions are termed invariants. These independent or invariant postulates lead to a form of differential element of interval which characterizes the space, whether free or in the presence of matter (a field of force). The relations between the coefficients of the differentials give

the new and general law of gravitation, in a brief symbolic form. Just as in two-dimensional surface the element of length is given by an expression $ds^2 = a\,dx^2 + b\,dx\,dy + dy\,c\,dy^2$ so in this four-dimensional "surface," the element of "length" is given by the ten-term expression $ds^2 = \Sigma g_{ik}\,dx_i\,dx_k$, where the summation extends over the values of one to four for both i and k and $g_{ik} = g_{ki}$. The relations between these quantities g form the general law of gravitation and determine the "curvature" of the new space, just as the relations between a, b and c determine the curvature of the two-space.

From approximations to the general gravitation or curvature symbols there are determined the expressions for the curvature of the light ray around the sun and the motion of the planet Mercury, which has received experimental confirmation. It is interesting to note that for small velocities the equations degenerate into the familiar Newtonian equations, in itself a satisfying confirmation of the validity of the Einstein formula.

The relations show that mass and energy are interchangeable (already proven in molecular electro-magnetic phenomena) and lead to a philosophic explanation that matter and energy are expressions of the way our senses perceive the curvature of the real space-time. Newton has given no explanation of matter and energy. Einstein attempts one.

A general knowledge of the nature of relativity and its methods, to the extent outlined in the preceding, should become part of the engineer's mental armament even though he makes no use of relativity conclusions in his practical work. Silberstein's book may be recommended to him as a guide in acquiring this knowledge, though as stated at the outset it is difficult.

Webb's Railroad Construction Revised

RAILROAD CONSTRUCTION: Theory and Practice—By Walter Loring Webb, M.Am.Soc.C.E., M.A.R.E.A., Assistant Professor of Civil Engineering (Railway Engineering) in the University of Pennsylvania, 1893-1901. New York: John Wiley & Sons, Inc. Flexible Binding; 4¼ x 7 in.; pp. 845 including two hundred pages of logarithmic tables; halftones and line cuts. $5.

Railroad engineers are so familiar with "Webb" that it is quite unnecessary to describe in detail the vast extent of ground that it covers. The seventh edition contains numerous corrections and revisions to make it conform to the decisions at the recent conventions of the American Railway Engineering Association. The more important of these are in the chapters and relate to the subjects mentioned below. In Chapter III, shrinkage of embankments and the subsidence of subsoil; VIII, the laws governing the life of ties and the development of substitutes for wooden ties; IX, present status of rail specifications, testing, life of rails, failures, intensity of pressure, and rail wear; X, rail joints and causes of failure; XII, water tanks and the principles of their construction; XIII, yards and terminals —which chapter was almost rewritten; XVI, train resistance, resistance of cars and switches; and a new chapter, XXV, which deals with static and dynamic stresses in track, rails, ties, and ballast.

South American Experiences of an Engineer

SIX YEARS IN BOLIVIA: The Adventures of a Mining Engineer —By A. V. L. Guise. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 243; halftone plates. $7.

Superintendence of a tin mine, building a road and rebuilding a suspension bridge, transporting steel plates and other metal work and machinery for a dredge over the mountains and down torrential streams, erecting the dredge and finally operating it in a gold dredging enterprise that did not pan out supply the background for this interesting book. The volume contains much about the life, work, laziness, whims and superstitions of native Indians, as also about men and women of other nationalities encountered in Bolivia and Peru. Native animals, vegetation, foods and drinks are also described. Good halftones are effectively used. The book is a worthy addition to the reminiscences of other mining engineers noted in these columns within the past two or three years. It raises anew the question: Why do not civil engineers do more such autobiographical writing as has been so ably done by mining engineers of late?

Completion of a Brilliant Work

THE OUTLINE OF SCIENCE: A Plain Story Simply Told—Edited by J. Arthur Thomson, Regius Professor of Natural History in the University of Aberdeen. With 40 Colored Plates and 800 Illustrations in Black and White [in the entire four volumes]. Vol. IV. New York and London: G. P. Putnam's Sons. Cloth; 7 x 11 in.; pp. 867-1194. $4.50 a volume.

The brilliant style and interesting subject matter that have characterized the earlier portions of this work continue throughout the concluding volume. (The earlier volumes were noted in these pages as follows: I, July 20, p. 115; II and III, Oct. 19, p. 666). The fourth volume opens with a notable chapter on Bacteria by Sir E. Ray Lancaster. Sections follow on The Making of the Earth and the Story of the Rocks, the Science of the Sea, Electric and Luminous Organisms, the Lower Vertebrates, The Einstein Theory, Biology of the Seasons, What Science Means for Man (by Sir Oliver Lodge), Ethnology, Domesticated Animals, The Science of Health and Science and Modern Thought (the latter by the Editor). A classified bibliography and an index to the entire work close the volume.

It will be seen that the same illogical arrangement of contents as was noted in our review of Vol. II and III continues to the end, but this does not lessen the interest of the work nor materially affect the value of the subject matter, since the real function of the four volumes is to lead as many people as may be out of the humdrum of daily life and the ruts of specialization.

The section on the Einstein Theory seems well suited to give the general reader a fair conception of the nature of the theory. The article on The Science of Health deals admirably with personal hygiene. At least a few paragraphs on public health might have been of great influence and value.

The broad conceptions of science presented by Sir Oliver Lodge, and also by the editor in his concluding chapter, deserve wide reading by all who, like the engineer, are in danger of being blinded by specialism. And right here is one of the chief elements of value of these four volumes: They afford that larger view, not merely of science, but of life and humanity as well, that is essential to the rounding out of a man and the continued stimulus against mental stagnation which all specialists need, be they engineers, chemists, manufacturers, merchants or farmers. To have produced 1,200 pages of text and illumined the text with 800 illustrations, all well designed and wrought to serve the purpose of awakening, informing and leading on to more detailed reading all classes of scientists and "the man in the street," is an achievement deserving the chorus of commendation for Professor Thomson and his associates that has been raised by "The Outline of Science."

Material Handling

REVIEWED BY HAROLD T. MOORE
Industrial Engineer, Day & Zimmerman, Philadelphia

BELT CONVEYORS AND BELT ELEVATORS—By Frederic V. Hetzel, M. Am. Soc. M. E., M. Franklin Institute of Pennsylvania. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 333; halftones and line cuts. London: Chapman & Hall, Ltd. $5 (25s. net).

My acquaintance with the author of this book dates from 1901-03 when I was employed as a draughtsman by the Link Belt Co. and Mr. Hetzel was chief draughtsman. Later, Mr. Hetzel became chief engineer of the company named, which position he held for thirteen years. His outstanding qualifications include thoroughness and a remarkable memory for facts, figures and formulae, with a genius for analyzing and solving in a practical and economical way all problems in material handling and conveying. He is, therefore, eminently qualified to write authoritatively on the subject of this volume.

His new book is a thorough and practical treatise and presents for the general use of engineers and manufacturers specialized information and working formulae which are not included in trade catalogs and not widely known outside of the material-handling field. The book covers recent developments in both American and European practice. The information is impartially presented with no "axe to grind" and points out the merits of equipment for a particular service without attempting to boost the product of any favorite manufacturer.

The principles and reasons underlying the design, applications and service of belt conveyors and belt elevators for different classes of materials are fully discussed. The book is well illustrated with detail drawings, photographic views and charted curves. Tables of sizes, capacities, power consumption and other useful data are present in convenient form for engineers or manufacturers who have handling problems to solve. The text is concisely written, with frequent cross-referencing as well as mention of other sources of information. The book is a worthy and useful contribution to current technical literature.

The Municipal Bridge of St. Louis

THE MUNICIPAL BRIDGE OF ST. LOUIS: A Record of Municipal Effort—By William E. Rolfe, Associate to the President of the Board of Public Service, St. Louis, and Lucius H. Cannon, Librarian, Municipal Reference Library. St. Louis: Public Library. Paper; 7 x 10 in.; pp. 32; 1 halftone and 1 line cut. 15c.

When a great engineering structure is finished, those for whom it is built and who may naturally be expected to have the most pride in it more commonly ignore and forget about its noteworthy character than record the fact. There was a commendable habit, in years gone by, to issue a descriptive monograph upon the completion of a great bridge or dam or similar work of engineering skill. In recent years the custom has died out, but the authorities of the city of St. Louis have revived it with the issuance of a modest little pamphlet entitled "The Municipal Bridge of St. Louis: A Record of Municipal Effort." The authors, William E. Rolfe and Lucius H. Cannon, confine themselves to a bare matter-of-fact listing of the tedious chain of events from the first conception of the project of a "free bridge" to the final completion of its approaches—long after the bridge itself had been erected. The pamphlet is worth the attention of at least three classes of men: Bridge engineers, because the great double-deck spans of this structure mark one of the forward steps of the bridge constructor's art; municipal and other public service engineers, because of the complex problem of planning for both highway and railway service which the case presented; and all persons interested in civic progress, because there has rarely been so striking a case of the long continued wrestling of a large city with a railroad problem where all the corporate railroad interests were arrayed against the municipal purpose. There is a profound lesson in the case, too, in the fact that after this ambitious project to kill off the railway charge on all passengers and freight for crossing the Mississippi River, the so-called "bridge arbitrary," the charge is still maintained, and the project in this respect is apparently a failure. But it is likely that the bridge will live to fulfill its mission nevertheless.

Brown's Gas Directory Enlarged

BROWN'S DIRECTORY OF AMERICAN GAS COMPANIES and Gas Engineering and Appliances Catalog: Statistics of Gas Companies in the United States, Canada, and the more important companies of Mexico and South America; also Collected, Consolidated and Standardized Cataloged Data of Gas Equipment, Appliances and Supplies, with Indexes of Both Firms and Products — 1922 Edition. Compiled, Edited and Published Annually by Robbins Publishing Co., Inc., C. E. Reese, Editor. New York City. Cloth; 9 x 12 in.; pp. 966. $10; $7.50 to gas companies.

To the well known Directory, published annually since 1887, there has been prefixed what the publishers aptly describe as a catalog of catalogs containing needed information "about the products of every important manufacturer selling to gas companies," with the "material arranged systematically" and cross-indexed. This catalog fills about half of the volume. There follows statistical and descriptive information, with names of officials, of city gas plants, by-product coke-oven plants, and natural gas companies. Holding and operating companies are next inserted, after which come financial reports for the holding and operating companies and for manufacturing companies in the larger cities; the personnel and meeting dates of (1) state utility commissions and (2) gas associations. The volume concludes with a consolidated membership of all the gas associations, alphabetically arranged. The work as a whole is creditable. The only addition we would suggest is a reasonable amount of summary of the gas statistics, partly by states and partly by character of works and equipment.

Lecture Material on Water Supply

A LITTLE BOOK ON WATER SUPPLY—By William Garnett, M.A., D.C.L., Formerly Fellow of St. John's College, Cambridge. Cambridge: University Press. Cloth; 6 x 9 in.; pp. 144; halftones and line cuts.

Outside England, and perhaps within, the chief value of this book seems to lie in its condensed descriptions of the existing water-supply systems of London, Birmingham, Manchester and Glasgow, and its historical accounts of the water supplies of London and of ancient Jerusalem. Besides presenting material relating to specific water supplies, the author outlines the main elements of a water-works system, including sources and modes of supply, water treatment, pumping plants, reservoirs and distribution systems, and gives some idea of the factors affecting quality. The object of the volume is educational, both general and in public hygiene. It seems to go into detail unnecessary to either purpose and to be inadequate as regards the relations between water supplies and public health and out of date as to some of the examples of notable water-

works cited. Thus, the two Croton aqueducts and the New Croton Dam are described, but the far more notable Catskill Aqueduct and reservoirs, in use now for a number of years, are not mentioned.

PUBLICATIONS RECEIVED

New Books and Revised Editions

THE BUILDING LABOR CALCULATOR—By Gordon M. Tamblyn. Denver, Colorado: G. M. Tamblyn, flexible binding containing 58 loose-leaf sheets. $5; monthly service $5 extra.

Tables of constants, generally including examples for computing the cost of labor in all principal building operations, such as excavation, carpentry, masonry, concrete work, interior finish, heating and plastering. The monthly service offered at an additional charge affords a constantly growing and revised note book on building labor costs.

THE CONTROL OF QUALITY IN MANUFACTURE—By George S. Bradford, Consulting Engineer, M.Am.Soc.M.E., Society of Naval Architects and Marine Engineers, Society of United States Naval Engineers. New York: Ronald Press Co. Cloth; 6 x 9 in.; pp. 404; illustrated. $5.

DIE BISHERIGEN ERGEBNISSE DER HOLZPRUFUNGEN IN DER MATERIALPRUFUGSANSTALT AN DER TECHNISCHEN HOCHSCHULE STUTTGART — Von R. Baumann. Berlin: Julius Springer (for the Vereins deutscher Ingenieure). Paper; 8 x 11 in.; pp. 139, with portfolio of plates.

DIE TRAGFAHIGKEIT DER PFAHLE—Von Dr.-Ing. Heinrich Dörr, Karlsruhe. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 10 in.; pp. 68; 61 figures in the text.

ERFAHRUNGSERGEBNISSE ÜBER TROCKENBAGGERBETRIEBE: Verwendungsfähigkeit der heute gebräuchlichsten Trockenbaggergeräte und Transportmittel für den Kanal- und Eisenbahnbau und die Erfahrungssätze, die sich aus dem Vergleich der unter den verschiedensten Verhältnissen arbeitenden Trockenbaggerbetriebe ergeben—Von Dr.-Ing. Joachim Rathjens. Zweite neubearbeitete Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 9 x 12 in.; pp. 128; halftones, line cuts in text and folding plates.

Experience with a variety of equipment for the handling of heavy earthwork in the dry is here reviewed by a construction engineer of twelve years' service with various canal and railroad construction enterprises. The book is divided into three sections, of which the first describes the ordinary plant for dry excavation treating, (1) of the construction and capacity of various types of plant, (2) of the appropriate transport equipment and (3) special equipment for the handling of spoil. The second section presents in graphic and tabular form analyses of progress and cost data for various types of plant and the third section is devoted to a co-ordination and comparison of the data presented in the second part.

HANDBUCH FÜR EISENBETONBAU—In Vierzehn Bänden.—Herausgeben von Dr. Ingeniur F. Emperger, Oberbaurat, Regierungsrat in Patentamt in Wien. Zehnter Band: Die Künstlerische Gestaltung Der Eisenbetonbauten. Bearbeitet von E. Von Mecenseffy. Dritte Neubearbeitete Auflage. Paper; 7 x 10 in.; illustrated, chiefly with halftones.

Rewritten and enlarged edition of a unique illustrated review of the artistic development of reinforced-concrete construction.

HISTORY OF THE BARGE CANAL OF NEW YORK STATE—By Noble E. Whitford, Assoc.M.Am.Soc.C.E., Senior Assistant Engineer, State Engineer's Department. Albany, N. Y.: State Engineer and Surveyor. Cloth; 6 x 9 in.; pp. 610; halftones.

HÜTTE. Hilfstafeln zur (1) Verwandlung von echten Brüchen in Dezimalbrüche. (2) Zerkegung der Zahlen bis 10,000 in Primfaktoren—Herausgegeben vom Akademischen Verein Hütte E. V. Third Edition. Berlin: Wilhelm Ernst & Sohn. Paper; 5 x 7½ in.; pp. 83.

INTRODUCTION TO THE CALCULUS—By William F. Osgood, Ph.D., LL.D., Perkins Professor of Mathematics in Harvard University. New York: Macmillan Co. Cloth; 5 x 7½ in.; pp. 449; illustrated. $2.90.

An enlarged revision of the author's "First Course in the Differential and Integral Calculus," published in 1921, "intended alike for the engineer or the physicist and for the student of pure mathematics," but essentially a college textbook.

THE MECHANINCAL HANDLING AND STORING OF MATERIAL—By George Frederick Zimmer, A.M.Inst.C.E. New York: D. Van Nostrand Co. Cloth; 8 x 11 in.; pp. 804; halftones and line cuts. $15.

QUESTIONNAIRE AND SCORE CARD APPLICABLE IN CHOOSING A COUNTRY PROPERTY—By Dr. William Paul Gerhard, Consulting Sanitary Engineer, 17 West 42nd St., New York City. Paper; 5 x 7 in.; pp. 11. 30c.

SEAGOING AND OTHER CONCRETE SHIPS—By N. K. Fougner, C.E., M.Am.Soc.C.E., Medlem Norsk Ingenieur Forening, Assoc.Inst.N.A. London: Henry Frowde & Hodder & Stoughton. Cloth; 6 x 10 in.; pp. 216; halftones and line cuts. Postpaid, 22s. American price, $7.

SICHERUNGSANLAGEN IN EISENBAHNBETRIEBE — Auf Grund gemeinsamer Vorarbeit mit Dr.-Ing. M. Oder, weiland Professor an der Technischen Hochschule zu Danzig, verfabt von Dr.-Ing. W. Cauer, Geh. Baurat, Professor an der Technischen Hochschule zu Berlin. Mit einem Anhang Fernmeldeanlagen und Schranken von Dr.-Ing. F. Gerstenberg, Regierungsbaurat, Privatdozent an der Technischen Hochschule zu Berlin. [Handbibliothek für Bauingenieure Herausgegeben von Robert Otzen.] Berlin: Julius Springer. Boards, cloth back; 7 x 10 in.; pp. 459; 484 figures in text and 4 folding plates.

An exhaustive review of modern practice in railroad signaling and safety appliances, including telephone service. Special emphasis is laid upon German practice, although there are included also brief descriptions of the characteristic features of foreign installations. The book is richly illustrated with line drawings and photographs that present in the greatest detail the various devices that enter into the signaling system.

STORES AND MATERIALS CONTROL: Including Procurement by Manufacture and by Purchase—By Madison Cartmell, A.B., Consulting Industrial Engineer, Assoc.M.Am.Soc.M.E., Member National Association of Cost Accountants. New York: Ronald Press Co. Cloth; 6 x 9 in.; pp. 459; line cuts. $4.50 net.

ZUR BESTIMMUNG STROMENDER FLUSSIGKEITSMENGEN IM OFFENEN GERINNE: Ein neues Verfahren—Von Dipl.-Ing. Oskar Poebing, Betriebsleiter des Hydraulischen Institutes der Technischen Hochschule München. Berlin: Julius Springer. Paper; 7 x 10 in.; pp. 56; 24 line cuts.

In what the author claims to be a new device for determining the flow of water in open channels the horizontal movement of a pivoted grid of small rods is recorded in terms of velocity.

Reports and Pamphlets in Various Fields

ANTISEPTIC TREATMENT OF SLEEPERS IN INDIA—By R. S. Pearson, C.I.E., Forest Economist. Technical Paper 231, Office of Chief Engineer (J. H. White) with the Railway Board, Simla, India. Paper; 8 x 13 in.; pp. 34; 1 diagram and 16 halftone plates. Rs. 1-4, from Superintendent Government Printing, 8 Hasting St., Calcutta, India.

That preservative treatment of railway ties in India will in a few years become an established industry is the author's prediction, based on ten years of experimental work with various timbers and processes. Creosote, petroleum oils, arsenic and zinc chloride with creosote were applied in open tanks and under pressure. Full-cell treatment is advocated in preference to open-cell treatment.

ASPHALTIC PAVING MIXTURES: Their Materials and Proportioning with Details of Plant Inspection—By W. J. Emmons, Professor of Highway Engineering, Agricultural and Mechanical College of Texas. College Station, Tex.: Texas Engineering Experiment Station. Paper; 6 x 9 in.; pp. 46.

BUDGETING FOR BUSINESS CONTROL—By Arthur Lazarus, Chief of the Cost Accounting Bureau, Fabricated Production Department. Washington, D. C.: Chamber of Commerce. Paper; 6 x 9 in.; pp. 51.

Gives reasons for budgeting, general methods and specific examples, the latter from operating concerns.

THE CHARACTER AND FUNCTIONING OF MUNICIPAL CIVIL SERVICE COMMISSIONS IN THE UNITED STATES—Report of the Committee on Civil Service Governmental Research Conference of the United States and Canada. William C. Beyer, Chairman, Committee on Civil Service, 1417 Sanson St., Philadelphia, Pa. Paper; 6 x 9 in.; pp. 103.

A general survey of American Civil Service Commissions, their powers, method of selecting members; with notes on civil service control abroad and employment administration in private industry and a recommended plant for reconstituting civil service commissions.

COMMERCIAL STATISTICS, 1921—Compiled by Statistical Division, Board of Engineers for Rivers and Harbors. Washington, D. C., Chief of Engineers, U. S. A. Paper; 6 x 9 in.; pp. 1326.

DEPRECIATION OF PUBLIC UTILITY PROPERTIES: Its Relation to Fair Value and Changes in the Level of Prices—By Henry Earle Riggs, M. Am. Inst. Consulting Engineers, M.Am.Soc.C.E., etc., Professor of Civil Engineering, University of Michigan. New York and London: McGraw-Hill Book Co. Cloth; 6 x 8 in.; pp. 211. $2.

FINANCIAL STATISTICS OF CITIES HAVING A POPULATION OF OVER 30,000: 1921—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 157.

FINANCIAL STATISTICS OF STATES, 1921—Washington, D. C.: Bureau of the Census. Paper; 9 x 11 in.; pp. 41.

Covers 30 of the 48 states (others failing to report); gives receipts and expenses, assessed valuation, taxes levied, indebtedness and assets; contains analyses by state departments.

IRRIGATION CANAL HEADWORKS — Lahore, India: Public Works Department, Irrigation Branch. Paper; 8 x 13 in.; pp. 19; folding plates of line drawings.

Designed for the guidance of officers in the Punjab Irrigation Branch; text by F. V. Elsden, executive engineer.

IRRIGATION PRACTICE AND WATER REQUIREMENTS FOR CROPS IN ALBERTA—By W. H. Snelson, A.M.E.I.C., Senior Irrigation Specialist. Ottawa, Ont.: Reclamation Service. Paper; 7 x 10 in.; pp. 59; line cuts, halftones and insert.

MANUFACTURED GAS, 1919—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 25.

MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH: Report for 1920-21—Boston. Cloth; 6 x 9 in.; pp. 386.

PAPERS ON HIGHWAY SUBJECTS—Before the Recent Conference on Education for Highway and Highway Transport Engineers, as follows: (1) Co-operation versus Competition between Motor Truck and Railroad Transportation, by W. H. Lyford, Vice-President, Chicago and Eastern Illinois Railway, Chicago. (2) Highways and the Taxpayer, by A. J. Brosseau, President, Mack Trucks, Inc., and Member of Highways Committee, National Automobile Chamber of Commerce. (3) Sending the Highway to School, by George M. Graham, Vice-President, Chandler Motor Car Company, and Member Highway Committee, National Automobile Chamber of Commerce. (4) Text Books and Overalls, by C. C. Hanch, Vice-President, Lexington Motor Car Company and Vice-President, National Automobile Chamber of Commerce. Reprinted as separate pamphlets by the National Automobile Chamber of Commerce, Inc., 366 Madison Ave., New York City. An abstract of Mr. Lyford's paper appeared in *Engineering News-Record*, November 30, page 933.

RESISTANCES TO THE TRANSLATION OF MOTOR VEHICLES—By T. R. Agg, Highway Engineer, Iowa Engineering Experiment Station and Professor of Civil Engineering, Iowa State College. Ames, Iowa: Engineering Experiment Station. paper; 6 x 9 in.; pp. 32; halftones and line cuts.

An account of methods and results of traffic resistance tests made at Ames, Iowa, up to the beginning of active field work in 1922. An article by Prof. Agg on this general subject appeared in *Engineering News-Record*, Dec. 7, 1922, p. 982.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

More on Comparative Heights of Dams

Sir—Those responsible for the Barcelona Company's work have always considered the Camarasa Dam second to the Arrowrock. The greater height recently claimed and discussed in your columns is based on measurements to the bottom of the cutoff ditch—about 97 meters (318 ft.). The height to the crest from the general level of the sloping bedrock is about 92 meters (302 ft.).

If the height from the lowest point of the cutoff ditch were to be accepted as a measure of the real height of a dam, the Talarn dam of the same company is still higher, this distance being over 104 meters (341 ft.); the dam is actually about 84 meters (276 ft.) from crest to general level of bedrock, and has never been claimed to be more than fifth among the higher dams of the world.

The accepted height of a dam should be that measurement, usually from the crest to the general level of base, which determines the computation of maximum stresses. A measurement to the lowest point of a cutoff or to the bottom of a pothole is hardly acceptable as a fair basis of comparison.

Mexico, D. F., Dec. 4. A. W. K. BILLINGS.
(Permanent address, Toronto, Ont.)

[First it should be noted that in the article by Mr. Ranney, noted below, which is largely the basis of the previous discussion of the general subject of dam heights, Mr. Billings is given as advisory engineer on the Camarasa Dam.

Earlier figures and discussions of this subject may be found in *Engineering News-Record* of the present year, as follows: Aug. 17, pp. 260 and 280, (1) article on the Camarasa Dam, by Willis Ranney, engineer of construction, and (2) review of seventh edition of Wegmann's "Dams"; Nov. 2, pp. 728 and 758, (1) editorial on "How High Is a Dam," and (2) letter from Edward Wegmann, "Which Is the Highest Dam"; Nov. 30, p. 946, letter from D. W. Cole, formerly engineer on the construction of the Shoshone and Lahontan Dams, U. S. Reclamation Service, entitled "A Dam Is as High as It Dams," in which Mr. Cole suggests two standards, "extreme height" and "effective height."

Mr. Billings sends cross-sections and profiles (not reproduced here) of the Camarasa and Talarn Dams, in Spain, discussed in his letter. From these and from a legend on a small cross-section in Mr. Ranney's article it appears that the extreme height of the Camarasa Dam (crest to the lowest point in the excavation, which is beneath the downstream side or the toe of the dam) is 101.6 meters or 333.33 ft. There is no similar legend on the Talarn drawings, but as nearly as can be scaled the height from the crest to the "bottom line of final upstream cutoff wall trench for sealing off dam foundation" is 106 meters or about 347.75 ft. Mr. Billings seems to have taken the general level of this cutoff wall instead of the lowest point as the base from which he computes his "over 104 meters (341 ft.)." The extreme height of the Arrowrock Dam was reported as 351 ft., when under construction; Wegmann gives it as 348.5; the latest report of the U. S. Reclamation Service gives it as 349 ft. The parapets are variously reported as 4 ft. high. The parapets of the Camarasa and Talarn Dams appear to be 3 to 4 ft. high. The parapets are not included in the extreme heights just given.

It would appear that (using Mr. Cole's "double standard") in "extreme height" the Arrowrock Dam is very closely followed by the Talarn, while in "effective height" the Talarn is well in the lead of Arrowrock, whatever its relation may be to other dams.

As to Mr. Billings' advocacy of "general level of base" as the datum of a dam, what is "general level"? Is it a mathematical average, and if so of what?

The whole matter of relative height comes back, as we said in the editorial already mentioned, to the purpose of the comparison, from which viewpoint there may be several heights for any one dam. When comparisons are attempted it is essential that the standards be the same.

Finally, anyone who will carefully examine the drawings of a number of dams, will be surprised to find how difficult it is to take off dimensions for accurate comparisons of their heights by the various standards that may properly be used. This is likely to be true of drawings made in one office at or near the same time. When many offices and dates are involved the difficulties and uncertainties become even greater.—EDITOR.]

Hoboken Water Rates Not Increased

Sir—Referring to an item in your issue of Dec. 14, p. 1043, headed "Higher Water Rates in Hoboken for the Hackensack Water Co.," may I ask you to kindly make the following correction:

The item states that the New Jersey State Supreme Court has referred back to the Board of Public Utility Commissioners of that state for revision upwards of a rate decision estimated to produce $913,785 of revenue in Hoboken for the Hackensack Water Co. This is incorrect. The figure mentioned is the estimated gross annual revenue for the entire system of the Hackensack Water Co. to be derived from rates fixed by the Board in its order and decision dated June 30, 1922, based on an average for the years 1920-21. The system embraces 46 municipalities, including the City of Hoboken.

Following the decision of the Board, dated June 30, 1922, the company appealed to the State Supreme Court, asking for an upward revision of rates for all districts except the City of Hoboken. The Hoboken rate was not involved in the appeal or in the decision.

New York City, Dec. 16. WALDO S. COULTER, Consulting Engineer.

Wire-Mesh Fencing Helps to Check Erosion

Sir—The article entitled "Bridge Protected from Shifting Channel" on p. 884 of the Nov. 23 issue of *Engineering News-Record* has an especial interest, as I had a very similar problem where a river was cutting away the bank, around a similar bend, immediately above a railway bridge consisting of two 100-ft. spans; the only difference being that the channel was of gravel formation instead of alluvial soil. By building flexible log-crib groins on top of a brush and wire mattress, laid on bed of river, an eddy was set up during flood time which caused a deposit of silt and boulders, thus rebuilding the eroded portion of the bank. On the earthwork approaches to the bridge, riprap and derrick rock originally were laid, but, as in the case mentioned in above article, this soon disappeared, having been carried away by the flood. I then laid a mattress of No. 9 woven-wire fencing (which is supplied in rolls about 60-in. wide) with brush for a foundation, and built up boulders and derrick rock on top of this to riprap the upstream side of the embankment. I completed the work by stretching similar wire fencing along face of riprap. This successfully withstood the action of flood as the material was all held in place by the wire, and the undermining of the foundation was checked by the mattress.

I have, with complete success, used the same type of wire fencing where the action of river had started to undermine foundations; and I note in your issue of June 8, 1922, p. 946, that in "Fighting the Mississippi Flood at Oldtown," the erosion of levees was finally checked by using 1-in. mesh chicken wire covered with two layers of cotton bagging. This appears to emphasize the usefulness of flexible wire-mesh in connection with river work. Many of the failures recorded have been caused by use of heavy reinforcing wire which is not sufficiently flexible to adapt itself to the outline of the eroded surface.

I always keep on hand a supply of wire-mesh fencing where sudden flood damage is likely to occur and it has never failed to give satisfactory results in an experience of over fifteen years, especially when used in conjunction with brush, trees or branches.

Victoria, B. C., Dec. 7. R. W. MACINTYRE.

Air Photos as Plane-Table Sheets Aid Mapping

Sir—In his article, "Air Photos as Plane-Table Sheets Aid Mapping," in *Engineering News-Record* of Oct. 5, 1922, p. 552, Major H. C. Fiske makes the statement that the total cost of producing the map (covering 33 sq.mi.) which he submitted to you was about $1,500. We also find that a field party of 12 men was on the ground for 38 calendar days. This figures out at $40 per day, nearly, for the field party alone, and allows a daily average of $3.33 per man to provide wages, meals, accommodation and other field necessaries. It takes no account, however, of airplane work, plotting, drawing, printing and other essentials.

As $3.33 per day for each man seems to be nearer to the minimum than the average for a survey party, and there appear to have been more men employed than the 12 already mentioned, not to mention the extras referred to above, the question your readers would like to have an answer to is: How can it be figured out that $40 per day will cover the *total* cost of such a survey? P. J. BARRY,

Winnipeg, Canada, Nov. 29, 1922.

[Mr. Barry's letter was submitted to Major Fiske, whose reply follows.—EDITOR.]

Sir—The object of my article which appeared in *Engineering News-Record* of Oct. 5 was to demonstrate, if possible, that the maps produced by our methods which included the use of aerial photographs are at least as good as, if not a little better than, the general run of maps prepared by ground methods alone and commonly accepted as standard. Costs were mentioned only to indicate that these are not excessive as compared with those of the old methods. With a view both to being brief and to keeping attention focused on the main object of the article, i. e., the generally satisfactory character of these maps, the large and important subject of costs was limited to one brief paragraph of only eight lines. When this paragraph is dissected it is clearly not consistent and since the point has been raised the seeming inconsistency should be explained.

The salaries paid the twelve men varied from $175 to $54 per month, the cost of subsistence being included in this amount. The party of twelve began work on the sheet in question on March 24 and finished on April 30, a period of 38 calendar days. The inference from the paragraph as written and published is clearly that these twelve men spent all of these 38 calendar days on this sheet and on this sheet alone. This inference is, however, not correct and I must apologize for not having been more explicit. As a matter of fact, the efficient prosecution of the field work of this party required, during this time, considerable field work to be done on other sheets at intervals by various members of this party. The published cost was figured from time actually spent by each member of the party on this particular sheet and was the equivalent of about 30 days (or a little less) for the entire party of twelve men. The total cost of about $1,500 includes then the total cost of the field work on this sheet, also the office costs and the estimated cost of the aerial work on these 33 square miles. The word "about" stands for a variation of something less than $100.

In order to forestall further queries it might be well to invite attention to the fact that in the December *Proceedings* of the American Society of Civil Engineers there appears a paper on this same subject by G. H. Matthes of this office in which, among other detail, he gives an estimate of cost of this work at $61 per square mile. The cost per square mile figured from my article in the *Engineering News-Record* comes to about $45.50. My article was written in June and relates to work done on one sheet prepared in March and April. Mr. Matthes' article was written in September and gave a summary of all the work done from the beginning up to that date. The work upon which he estimates is, we think, distinctly better than what we were able to do in April and more than justifies the additional estimated cost. At the same time we have no apologies to make for either the work or the estimate of April. The use of aerial photographs, etc., in map making is so new a process and so little experience along this line has yet accumulated that anything like an exact discussion of cost is difficult in the extreme. Such, at least, is the experience of this office and of other agencies, including some private concerns who have entered this field, with whom we have been brought in contact. But though costs may be variable it does not by any means follow that they are high as may be gathered from the following case.

Some time ago the chief engineer of the Alabama Power Co., having become interested in this subject, visited this office to learn in some detail what we had been doing along this line. He was so favorably impressed that he then sent some of his engineer assistants here to examine thoroughly into our methods, costs, etc. The final result is that this company is about to adopt the use of aerial photography in connection with the mapping of something like 500 sq.mi. of territory. I anticipate that this company will use substantially the same methods as those worked out last winter and spring on the Tennessee River. If this method is adopted by them it will certainly be because the officials of this company have satisfied themselves that they will in this way obtain a more satisfactory map at a smaller expenditure of time and money than could be secured by ground surveys alone, but I doubt if they would like to commit themselves to any advance estimate of actual cost.

To my mind a just conclusion at this time is that because of the newness of this method and the constant experiments which need to be tried out, cost discussions are for the present quite premature. Nevertheless, within the limits of the experience had on the Tennessee River we are satisfied that maps equal or superior to those made by ground surveys alone can be made quicker and cheaper by the use of aerial photographs. HAROLD C. FISKE,

Major, Corps of Engineers, U. S. Army.

Chattanooga, Tenn.,
Dec. 12, 1922.

Meters and Master Meters on Water-Works

Sir—Technical publications for the last few years have stressed the importance of metering the services on all water-works systems. This is an important subject and the writer firmly believes in 100 per cent metered systems.

The water-works fraternity, however, should be reminded occasionally of the metering of their supply lines. It recently was called to my attention that a western city voted a bond issue for over a half million dollars for improvements to its water-works system and the engineer employed to design this system had absolutely no record of the amount of water used by the city per day nor any information as to hourly or seasonal variations in the use of water. This information could have been obtained by means of a Venturi meter, a pitot tube or several other instruments. The cost of an installation of this kind could undoubtedly be saved, many times over, in the redesigning of the new system, if the data which would have been furnished by a Venturi meter had been available.

Water-works men should remember that their system is not 100 per cent metered until they can check the flow through their supply lines, and submains as well as services.

Salt Lake City, Utah, Dec. 5. C. E. PAINTER.

Test Duration of Fires in Various Occupancies

Experimental work has been begun at the Bureau of Standards to determine the length and intensity of fire exposure likely to occur in various occupancies, information needed for proper selection of the structural elements of buildings with regard to degree of fire resistance. The first test has been completed. It was made on a one-story brick and concrete building 16x30 ft. fitted up to represent office occupancy. In this case, temperature readings showed that the fire was somewhat more severe than a one-hour standard fire test. The influence of the dimensions of the room on intensity and duration may be studied more fully in further tests.

NEWS OF THE WEEK

New York, Desember 21, 1922

Await Advance Report of Coal Commission

Chairman Forecasts Drastic Proposals for Industry—Not to Mediate in Adjustment of Wages

Washington Correspondence

While Jan. 15 hangs over the President's Coal Commission like the sword of Damocles, it is believed that enough data can be analyzed to permit of a preliminary report that will have weight with the industry, as well as with the public. Machinery such as the commission must set up, is ponderous. It takes a long time to get it in working order, but, once in operation, a great deal can be accomplished in a short time. Chairman Hammond illustrates the situation by stating that the commission now is getting the "miners' eye," referring to the fact that some time must be spent underground before the human eye adjusts itself to the darkness of a mine. Then too, the efficiency of the commission, he admitted, has been improved since the members, latterly, have provided themselves with gas masks.

Chairman Hammond states most emphatically that the commission's report will not be a "wishy-washy affair." It will contain some rather drastic suggestions, as it is believed that bold surgery is necessary, if the source of the ills of the coal industry are to be reached.

Will Avoid Wage Mediation

It was emphasized by Mr. Hammond and by Dr. Smith, in verbal statements to the Washington correspondents on Dec. 16, that the commission will not undertake anything that can be interpreted as mediation in wage scales. That is the responsibility of the operators and the mine workers, it was said, and while the commission will use its moral influence to induce them to get together and will emphasize to both operators and mine workers the far-reaching consequences likely to follow another strike, it will do nothing more than to submit to Congress facts and conclusions.

Over-expansion in the coal industry, Mr. Hammond stated, is not confined to the producers. Both wholesalers and retailers, he declared, complain because there are too many engaged in the wholesaling and retailing of coal. This condition adds greatly to the burden that the consumer must bear, Mr. Hammond said.

Since the large number of organizations engaged in jobbing and retailing coal results in much duplication and the aggregate of needless overhead is large, it is not difficult to point out superfluous additions to the selling price, but it is difficult to suggest means whereby the eliminations can be made so that the wholesalers and retailers may be reduced in number.

Quebec Province Lets Contract for $12,000,000 Hydro Dam

The Provincial Government of Quebec has awarded a contract to the Quebec Development Co. for the construction of a dam at the Grand Discharge from Lake St. John, the headwaters of the Saguenay River, for the development of 200,000 electrical hp. The cost of the project is estimated at $12,000,000 and work will commence as soon as possible. It is expected that the work will consume two or three years.

According to an announcement made by Premier Taschereau of Quebec the Grand Discharge dam is the initial step in a large project for the development of 1,000,000 hp. of electrical energy.

50-Ft. Section of 12-Ft. Wood Pipe of Hydro Plant Collapses

The 12-ft. wood-stave pipe of the Salmon River plant of the Niagara, Lockport & Ontario Power Co. collapsed for a length of approximately 50 ft. on the evening of December 6. This collapse was caused by a large collection of surface ice on the screens at the pipe intake. There had been a strong wind during the day which had broken up the ice on the pond. Upon taking an extraordinary draft of load much of this ice was sucked under and lodged on the screens, causing the pipe to collapse.

A 6-in. air valve was located in the pipe within 200 ft. of the break. Telltales show that this valve opened, but evidently it was not large enough to relieve the suction.

Repairs were effected within a week. There was no interruption to service on the company's system.

Another Bridge at Minneapolis Is Being Planned

Minneapolis is planning construction of a new bridge over the Mississippi River, making the tenth public bridge over the river in the city. The structure will be of concrete, 2,800 ft. long, with approaches, and will extend from Cedar Ave. and Second St. on the west side to University and Tenth Aves., Southeast. Plans now being made by N. W. Elsberg, city engineer, provide for two main spans of 280 ft. each, and one 100-ft. span on each side, bent-and-beam construction to be employed for the rest of the length. The width will be 60 ft., including a 40-ft. roadway. The cost is estimated at around $900,000, and work will be done by day labor under direction of the city engineering department. Construction is expected to begin within a few months, and three years may be required for completion.

Plans have been completed, also, for a concrete bridge over Minnehaha Creek, at Nicollet Ave., to cost about $250,000. It will be 823 ft. long and 60 ft. wide.

Countervailing Duties on Cement Declared Against 10 Countries

Washington Correspondence

Although cement is on the free list of the new tariff act, the Treasury Department has declared countervailing duties on cement imported from ten countries. The action is in accordance with the proviso of the cement paragraph which reads:

"Provided, that if any country, dependency, province or other subdivision of government imposes a duty on such cement imported from the United States, an equal duty shall be imposed upon such cement coming into the United States from such country, dependency, province or other subdivision of government."

The countervailing duties, declared on the basis of the foreign tariffs set forth in the order, conversion to be at current rates of exchange, are:

Canada, 8 cents per 100 lb.; France, 0.60 paper francs per 100 kilos for rapid setting and 0.90 paper francs for slow setting; Germany, 0.50 gold marks per 100 kilos; Italy, 1.125 gold lire per 100 kilos for quick hardening cement and 1.75 gold lire per 100 kilos for other cement; Japan, 0.30 gold yen per 100 kin; Mexico, 0.01 silver pesos per kilo; Norway, 0.20 gold crowns per 100 kilos; Poland, including Danzig, 1,000 paper marks per 100 kilos; Sweden, 0.60 gold crowns per 100 kilos; British Virgin Islands, 3s. 9d. per 400 pounds.

Until the figures of imports since the new tariff act became effective Sept. 22 are made available the effect of the countervailing duties will be difficult to estimate. Compilation of imports has been greatly delayed. Unofficial reports to the Department of Commerce and the Customs Division of the Treasury Department regarding the volume of cement imports are conflicting. Several domestic producers have called attention to imports from Canada and the first countervailing duty ordered was directed against that dominion.

Kansas City Water Commission Held Illegal Body

By a decision of the Supreme Court of Missouri the Kansas City Water Commission, which was to have expended the proceeds of an $11,000,000 bond issue for extensions and improvement of the water supply, has been held to be an illegal body. The main contention was that the personnel of the board was named in the ordinance voted upon, thus permitting no choice on the part of the voters. An application of the commission to the City Council to authorize the sale of $2,000,000 worth of bonds to start the work has been held up for several months but the money was immediately made available when the court decision was handed down automatically putting the water-works back into the hands of the existing Fire and Water Board.

N. Y. Port Authority Seeks Aid of Commerce Commission

Following conferences between the Port of New York Authority and the Interstate Commerce Commission the latter body has summoned the twenty railroads entering the port to show cause why they should not co-operate with the Port Authority in carrying out its comprehensive plan for the unification of the port facilities.

Since its organization last spring the Port Authority has been developing plans for a co-ordination of the transportation facilities of New York harbor and has been trying to obtain the voluntary co-operation of the carriers in carrying out these plans. It now announces that it has exhausted its efforts in this direction and that it deems it necessary to invoke the assistance and co-operation of the I.C.C.

Hearings will be held at times and places to be designated by the commismission, after which it is expected that appropriate orders will issue. News reports indicate that the roads are not over friendly to the proposal and it is quite possible that the hearings may give rise to an open opposition.

Science Body To Hold Special Engineering Sessions

The Engineering Section of the American Association for the Advancement of Science, known as Section M., of which F. M. Feiker, vice-president of the McGraw-Hill Co., Inc., is chairman, has arranged a special program for the annual meeting to be held this year at the Massachusetts Institute of Technology, Dec. 26-30.

Speakers who will appear at this meeting and their subjects are:

Dr. J. B. Tyrrell, of the A.I.M.E., Toronto, Can., "Growth of the Mining Industry in Canada"; Dr. Ira N. Hollis, president of Worcester Polytechnic Institute, "Progress and The Engineer"; Dr. C. F. Scott, professor of electrical engineering, Yale University, "New Phases of Engineering Education"; and Harrington Emerson, of the F.A.E.S., "Prevention of Waste in Industry." This session will be held Friday afternoon.

In addition to the program for Section M a joint session has been arranged with Section K, (section on Social and Economic Sciences), for the evening of Dec. 29, at which Calvin W. Rice, secretary of the American Society of Mechanical Engineers and delegate to the recent International Engineering Congress at Rio de Janeiro, will deliver an illustrated lecture on engineering development in South America.

On the morning of Dec. 29, Section M and Section K will hold a joint session with a special group of speakers on the "Engineer's Relation to the Conservation of National Resources." The following is the program:

"Conservation and Industrial Waste," by John T. Black, State Health Commissioner, Hartford, Conn.

"The Federal Water Power Policy and its Results," by O. C. Merrill, secretary, Federal Power Commission, Washington, D. C.

"Conservation of Power," by William S. Murray, New York City.

"Problems of Flood Control," by Brig.-Gen. Harry Taylor, in charge of government flood control work, Corps of Engineers, U. S. A., Washington.

The Engineer in Public Life

W. A. STANFIELD

Topeka, Kans., selects the commissioner of its Water and Light Department by popular vote. In 1919 the electorate chose an engineer, W. A. Stanfield, for this post, and gave their endorsement of his 2-year administration of the department's affairs by re-electing him in 1921. Commissioner Stanfield was born in Topeka in 1876. He has come up to his present position through the ranks, having started work as machinist's apprentice at Lawrence, Kans., in the shops of the Consolidated Barbed Wire Co. In 1897 he became connected with the American Steel & Wire Co. of Joliet, Ill., and two years later went to Newport News, Va., as erecting engineer on government shops. After a period as testing engineer with the Santa Fe R.R., he helped organize the Machinist Electric Co., and served as mechanical engineer of that organization.

In his capacity as water commissioner Mr. Stanfield has been instrumental in securing the approval by a 6 to 1 majority of a $535,000 water and light bond issue. Under his administration the electric light and water departments have been consolidated and the city has built a 10,000,000-gal. per day filtration plant placed in operation this year.

Engineering Societies to Honor New Italian Ambassador

Prince Gelasio Caetani, Italian Ambassador to Washington and an engineer by profession, will be the guest of the American Engineering Council of the Federated American Engineering Societies at a dinner in his honor to be held in Washington on Jan. 12 in connection with the annual meeting of the council.

Plans have been made also for a dinner in honor of Prince Caetani to be tendered by the National Engineering Societies in New York probably late in February. The new ambassador was graduated from the School of Mines of Columbia University in 1903, after which he engaged in mining work in this country until he returned to Italy on the outbreak of the war.

C. A. Emerson, Jr., to Join Staff of Fuller & McClintock

C. A. Emerson, Jr., chief of the Engineering Division of the Pennsylvania Department of Health, has resigned his position to join the staff of Fuller & McClintock, consulting engineers, New York City, in an office to be opened in Philadelphia in January. Mr. Emerson has been with the Pennsylvania State Department of Health since 1910, as principal assistant engineer, acting chief engineer and chief engineer.

E. J. Kelly Elected Chief Engineer of Chicago Sanitary District

E. J. Kelly, South Park Commissioner, Chicago, and a consulting engineer, has been elected chief engineer of the Sanitary District of Chicago by the board of trustees. H. P. Ramey, acting chief engineer during the absence on leave of A. W. Dilling, the chief engineer, has been appointed assistant chief engineer. Edward F. Moore, Mr. Ramey's predecessor, has been made chief operating engineer.

Up to two years ago when Mr. Kelly retired from the position of chief engineer and entered private practice he had been in the service of the district in various engineering capacities for twenty-six years. In 1915 he was made assistant chief engineer of the Sanitary District of Chicago and in that year was appointed a member of the Illinois Waterways Commission, which was to undertake an 8-ft. waterway from the Chicago drainage canal at Joliet to the Illinois River at La Salle.

Mr. Kelly will retain the appointive office of South Park Commissioner, as it carries no salary.

Mr. Ramey has been in the service of the Sanitary District of Chicago since his graduation from the University of Michigan in 1907. From 1908 to 1910 inclusive he was in the office of the chief engineer, on hydraulic design. In 1910 he was on construction of channel work, sewers, bridges and the north half of the North Shore channel, and in 1911 worked on the construction of draft tubes for and the installation of the 6,000-hp. water-wheel unit at Lockport powerhouse. He was made acting chief engineer of the Sanitary District in August, 1922.

Mr. Moore, a former business agent of the Hoisting and Portable Engineers' Union, was appointed assistant chief engineer of the Sanitary District in 1921. He studied at De Pauw University and from 1916 to 1921 was a member of the Chicago Board of Examining Engineers. He has worked for several years with Chicago contractors; included among whom were the Foundation Co. of Chicago, John Griffith & Sons Co., and Newman Co. For two years he was employed on the Mayfair shaft of the Wilson Ave tunnel.

To Study Detroit Transit Needs

A committee of five engineers is to study the rapid-transit needs of Detroit. The four names thus far announced are C. W. Hubbell, formerly city engineer of Detroit; Willard Pope, vice-president, the Canadian Bridge Co.; H. W. Alden, vice-president, Timken-Detroit Axle Co., and, as chairman, Sidney D. Waldron, a former vice-president of the Packard Motor Co. An appropriation of $50,000 for the study has been made. The needs of the proposed metropolitan district will be considered.

Awards Contract for Sinking Narrows Tunnel Shaft

Contract for the sinking of the Brooklyn shaft of the Narrows tunnel between Brooklyn and Staten Island was awarded on Dec. 15 to Patrick McGovern, Inc., whose bid of $494,538.75 was the lowest of seven submitted at the opening on Nov. 24.

Cantilever Plan Recommended for Highway Bridge Over Hudson River at Poughkeepsie

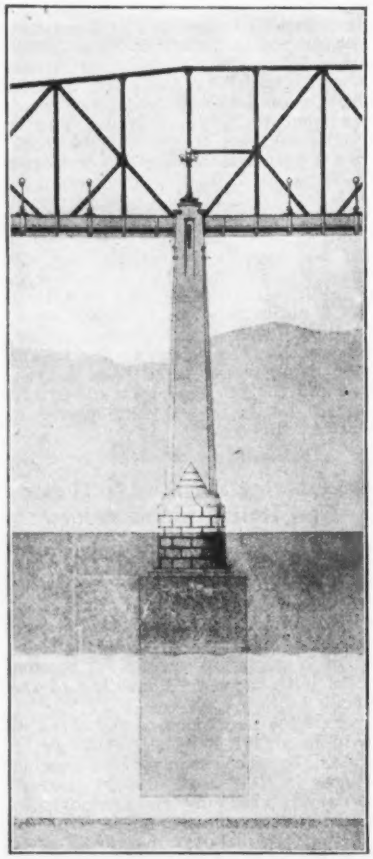
Report to Citizens' Committee Proposes High-Level Through Bridge of Seven Spans to Cost $5,000,000

ENGINEERING reports on the project of building a highway bridge over the Hudson River at Poughkeepsie have just been rendered to a local citizens' committee, Theodore D. Pratt reporting on traffic and George W. Goethals & Co. on structural design. The reports urge the construction of the bridge as being needed by present traffic demands and still more so by the traffic of the future, and recommend a through cantilever design for a high-level bridge of seven spans, five of which would be 540 ft. long. The structure as designed would cost over $5,000,000; the estimate totals $4,898,976, exclusive of land, easements, and interest during construction.

From a traffic survey Mr. Pratt finds that there is at present an average summer traffic over the Poughkeepsie ferry of 1,200 vehicles per day. Between New York and Albany (where the first highway bridge is located) there are nine ferries, at Nyack, West Point, Newburgh, Poughkeepsie, Kingston, Saugerties, Catskill, Hudson, and Coxsackie, of which, however, five are unimportant, with small traffic, and the other four (at Tarrytown, Newburgh, Poughkeepsie, and Kingston) are inadequate for the demand. Both local and through traffic requires to be cared for, the former comprising the movement of agricultural produce and fruit grown in the district west of the Hudson to the cities on the east bank. Comparison is made of the three locations said to be the most suitable bridge sites in the central section of the Hudson River, namely at Anthony's Nose, at Poughkeepsie, and at Crum Point (four miles above Poughkeepsie), and the Poughkeepsie site is reported to be the most favorable both topographically and because of leading direct to a city. A highway bridge at Poughkeepsie would also have strategic importance in case of war, the report states.

A cantilever structure, as shown in the illustrations herewith, is recommended by George W. Goethals & Co. and Henry Goldmark, consulting engineers reporting on the structure. It is the result of a study of a suspension design, and through and deck cantilever designs. War Department requirements make it necessary to place piers in line with the piers of the Central New England railroad bridge, half a mile above the selected bridge site. This would necessitate a 1,620-ft. main span for a suspension bridge, which in view of cost and traffic requirements is stated to preclude further consideration of this type.

The design recommended is for a through riveted cantilever bridge of five main spans, with about 140 ft. clearance above high water and trusses 30 ft. apart center to center, providing a 24-ft. roadway and two sidewalks of 8 ft. each. The main spans are 540 ft. long, and the east and west anchor arms 300 ft. and 180 ft. respectively, making a total length of steel structure of 3,180 ft., flanked by 1,100 ft. of earth fill and concrete arch approach on the east bank, and 250 ft. of earth-fill approach on the west bank. The trusses would have a maximum depth of 77 ft. A total of 6,338 tons of steel is estimated for the superstructure. The piers would be open-well piers sunk 120 ft. to gravel directly overlying rock. The substructure cost is estimated at about $3,000,000 and the superstructure cost at about $1,100,000. Together with about $400,000 for the approaches and a 10 per cent allowance for cost of engineering and supervision, the estimated total becomes $4,898,976. Real estate and interest on construction are not included. The possibility of working out a more economical foundation with the use of piles protected against scour is suggested. The report finds that such a bridge may be built ready for traffic in twenty-four months.



The project is being promoted by the Hudson Valley Bridge Association, made up largely of Poughkeepsie citizens, and aims to secure the construction of the bridge by the state as a free bridge. A bill providing for the construction by the state has already been prepared and is to be introduced into the legislature shortly.

France to Keep State Telephones

News cables from France carry a denial by the Minister of Posts and Telegraphs of the report that the government intends to turn over to a private company the control of its telephone system. This suggestion has been made from time to time but it has not yet won the approval of the present Minister or of the Chamber of Deputies.

Another Pennsylvania Bridge Destroyed by Auto

A 70-ft steel span over Bushkill Creek near Tatany, Pa., was destroyed on Nov. 25 by the impact of a passenger automobile, which struck one of the intermediate posts of the bridge. The post was knocked out and the span collapsed, falling 10 ft. to the creek bed. According to a local account, the automobile was "considerably damaged." A similar accident, which destroyed a 100-ft. span near Tyrone, was noted Nov. 23, p. 905.

A. A. E. to Hold 1923 Meeting in Norfolk, Va.

The ninth annual convention of the American Association of Engineers will be held May 7-9, 1923, in Norfolk, Va.

PROPOSED HUDSON RIVER HIGHWAY BRIDGE AT POUGHKEEPSIE, LOOKING DOWNSTREAM; ABOVE, A PIER DETAIL

No highway bridge now exists south of Albany, 150 miles above New York harbor. Poughkeepsie is the half-way point in this distance. The site of the proposed bridge is half a mile below the existing railroad bridge.

Names Sub-Committees on Fees and Services of Engineers

Specific problems are being taken up this year by the committee of the American Association of Engineers on services and fees of practising engineers. L. E. Ayres, chairman of the committee, has outlined the work as follows and obtained approval for carrying it out from the board of directors:

To sub-committee 1 is assigned the task of preparing rules of practice. The plan is to have the rules prepared by engineers of wide reputation who are held in high esteem by professional men everywhere with the idea that their preparation and publication will be as important an achievement as was the code of ethics prepared by the late Isham Randolph and published by the association. The personnel of the committee is as follows: Henry E. Riggs, chairman; George W. Fuller, C. W. Hubbell and Daniel W. Mead.

A second sub-committee headed by H. S. Kleinschmidt will extend and elaborate the schedule of fees heretofore prepared by the general committee.

Sub-committee 3, with W. A. Artingstall as chairman, will study problems arising out of the practice of public employees engaging in private practice.

The function of a fourth sub-committee, of which J. W. Cunningham is chairman, will investigate problems involved in connection with the federal government taking over in increasing measure engineering service, having especially in mind the work of the engineering staff of the U. S. Reclamation Service.

Ohio River Improvement Is Progressing Favorably

As a result of the unusual extent of favorable weather, the amount of work done on the slack water navigation improvement of the Ohio River has exceeded all expectations. The objective being sought is to provide a minimum depth of 9 ft. from Pittsburgh to the mouth of the Ohio. A 9-ft. channel already exists from that point to the Gulf of Mexico, through the Mississippi.

From Pittsburgh to Dam 26, a distance of 278 miles, a reliable depth of 9 ft. throughout the year has been provided. From Dam 26 to Louisville eight dams have been completed and six dams are under active construction. When those dams will have been completed, the 9-ft. depth will be made continuous to Louisville. It already is possible to move the coal fleet from the Kanawha and other tributaries through that section at low water by releasing water from the completed pools. This is at the expense, however, of continuous navigation.

Below Louisville two dams have been completed and two are under construction. Seven dams and possibly an eighth are to be constructed in that section. Since there is naturally greater depth in that section, navigation can be maintained through it at low water even now. The work has reached a point where each year will make for much more satisfactory navigation conditions at low water. Four years hence, it is believed the river will have been made a very satisfactory stream for navigation purposes, but the project is not likely to be accomplished before 1930.

Would Have Railroads Mine Coal

Washington Correspondence

One of the most reactionary suggestions, that has been made to the President's Coal Commission, has come from a prominent source, generally regarded as being radical. The suggestion is that the coal mines should be turned over to the railroads to operate. The opinion is expressed that since the railroads use thirty per cent of the coal, since it constitutes forty per cent of the total tonnage they haul, and since transportation is the most important single element entering into the instability of the coal industry, the railroads could operate the mines more effectively than could the government or individual operators.

"Tech" Alumni Join in Greeting to President Stratton

President S. W. Stratton, newly-elected head of Massachusetts Institute of Technology, was the guest of honor at an All-Technology dinner held at the Hotel Biltmore, New York, on the evening of Dec. 16, in connection with the annual meeting of the Technology Clubs Associated on Dec. 15 and 16. The dinner was held under the joint auspices of that organization, the M. I. T. Alumni Association and the Technology Club of New York.

Greetings to President Stratton were extended by Harry J. Carlson, president of the Alumni Association; Arthur T. Hopkins, president of Technology Clubs Associated; Robert Starr Allyn, president of the Technology Club of New York; James T. Monroe, secretary of the corporation of M. I. T.; and Dean Henry Talbot, on behalf of the faculty. Telegrams were read from "Tech" men all over the country. His reply was broadcast by radio for the benefit of all "Tech" men east of the Mississippi. In referring to the work of the Bureau of Standards in connection with the development of radio broadcasting, President Stratton announced that in the near future the wave-length allotted to amateurs will probably be extended.

Indian Railway Asks Bids for Bombay Electrification

Bids for overhead equipment, distribution lines and car equipment for the electrification of the suburban railway system at Bombay are invited by the Great Indian Peninsula Ry. Co. The proposed work was outlined briefly in *Engineering News-Record* of Sept. 21, p. 485. Merz & McLellan, London, are the consulting engineers. Bids are to be sent to the company's offices at 48 Copthall Avenue, London, England, before Jan. 9.

Ship 8,500-Ton Cargo of Steel by Ohio-Mississippi Route

News dispatches from Pittsburgh announce that the first attempt to ship steel on a large scale by river is now on. A cargo of 8,500 tons of pipe, structural shapes and bars, in ten barges has been sent by the Carnegie Steel Co. from Pittsburgh down the Ohio and the Mississippi to New Orleans. Deliveries are to be made en route at Evansville and St. Louis. The rivermen expect to complete the trip in twenty days.

I.C.C. Announces Further Hearings on Railroad Consolidations

Hearings in the matter of railroad consolidations will be resumed before the Interstate Commerce Commission in Washington, on Jan. 17, 1923. Evidence will be received with respect to carriers which, under the tentative plan, should be considered in connection with the following proposed systems as there outlined, or in connection with such alternative systems as may be proposed:

System No. 13—Union Pacific-North Western—Union Pacific, including the St. Joseph & Grand Island, Oregon Short Line, Oregon-Washington R.R. & Navigation Co.; Los Angeles & Salt Lake; Chicago & North Western, including the Chicago, St. Paul, Minneapolis & Omaha; Lake Superior & Ishpoming; Wabash lines west of the Mississippi River.

System No. 16—Santa Fe—Atchison, Topeka & Santa Fe, including the Gulf, Colorado & Santa Fe; Colorado & Southern, including the Fort Worth & Denver City; Denver & Rio Grande, Western Pacific, Utah Railway, Northwestern Pacific, Nevada Northern.

System No. 17—Southern Pacific-Rock Island—Southern Pacific Company, Nevada Northern; Chicago, Rock Island & Pacific, including the Chicago, Rock Island & Gulf; Arizona & New Mexico, El Paso & Southwestern, San Antonio & Arkansas Pass, Trinity & Brazos Valley, Midland Valley, Vicksburg, Shreveport & Pacific, Chicago, Peoria & St. Louis.

Because of the inability of certain respondents tentatively included in Systems No. 14—Burlington-Northern Pacific and No. 15—Milwaukee-Great Northern to prepare evidence forming part of their main affirmative cases in season for presentation during December, no assignments for western hearings during that month have been made. These respondents are invited to present their further evidence at the hearing commencing on Jan. 17. Respondents named in Systems No. 18—Frisco Katy Cotton Belt and No. 19—Chicago-Missouri Pacific have been notified to be prepared to make their main affirmative cases at Washington on short notice at any time after January, 1923.

N. Y. Railroad Club Celebrates Fiftieth Anniversary

More than 2,000 attended the golden jubilee dinner of the New York Railroad Club held at the Hotel Commodore in that city on Dec. 12. Addresses dealing with current problems of railroad management and with the record and service of the club in the railroad field were made by John J. Cornwell, ex-governor of West Virginia and now general counsel, B. & O. R.R.; and George A. Post, chairman of the railroad committee, Chamber of Commerce of the United States. William G. Besler, president of the C. R. R. of N. J., presented a silver cup to retiring President John A. Droege. F. T. Dickerson, secretary and treasurer, C. R. R. of N. J., is president of the club, and H. H. Vreeland, vice-president of the Interborough Consolidated Corp., acted as toastmaster.

Civil Service Examination

UNITED STATES

For the United States civil service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Valuation Engineer and **Associate Valuation Engineer**—vacancies in the technical staff of the Income Tax Unit of the Bureau of Internal Revenue, Treasury Department, Washington, D. C., on oil and gas and coal mining at $3,600 to $4,000 a year for the valuation engineer and $3,000 to $3,600 for the associate valuation engineer. Applications must be filed with the Civil Service Commission, Washington, D. C., before March 1, 1923.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17-18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7 to 9, 1923.

The New York Section of the American Society of Civil Engineers, at its meeting of Jan. 10, 1923 in the Engineering Societies Building, New York City will discuss the "Operation of the Panama Canal." It is expected that the subject will be presented by Governor Jay J. Morrow of the Canal zone and that there will be on hand to discuss it representatives of the steamship companies that use the canal.

The Texas Water Works Association will meet in Dallas, Jan. 15, 1923, and hold a six-days' short course for water-works operators. This course has been given for several years and will be the second held in Dallas. E. E. Sands, John B. Hawley, J. M. Powell, C. M. Adams, Dr. R. V. Davidson and others will be on the school faculty. Most of the work which is of a highly practical nature will be given at the new White Rock filtration plant.

The Wichita Falls Technical Club composed of members of the technical and associated professions at Wichita Falls, Texas, has been formed with 85 charter members, civil, electrical, mechanical, and chemical engineers, geologists, architects, contractors, and public utility men compose the personnel of the club. Following are the officers: Julian Montgomery, president; R. A. Thompson, 1st vice-president; A. M. McPherson, 2nd vice-president; A. H. Douglass, secretary-treasurer.

The Providence Engineering Society and the American Institute of Electrical Engineers held a joint meeting in Providence, R. I., Dec. 19, at which was given an address by Admiral William S. Sims, U. S. Navy, resigned, on "The Relationship of the Navy and the Merchant Marine."

Personal Notes

W. V. BUCK, assistant state highway engineer, Kansas Highway Commission, has tendered his resignation to take effect Jan. 1, 1923. Mr. Buck is to enter the automobile business at Newton, Kansas.

R. C. HAM, county engineer of Ford County, Kansas, has resigned to accept the position of county engineer of Jefferson County, Kansas.

CHARLES H. WINDHAM has been elected city manager of Long Beach, Calif., by the city council, to succeed Charles Hewes, recalled by the voters ten days ago. At the time of his election Mr. Windham was postmaster and he had formerly been mayor of Long Beach.

ROBERT L. E. WARD, formerly with Weiland Engineering Co. of Canon City, Colo., is now employed with the Southern California Edison Co. as construction foreman on the Laguna-Bell substation at Los Angeles.

W. E. BAKER, formerly assistant supervisor at Derry, Pa., for the Pennsylvania R.R., has become supervisor for the Pennsylvania R.R. at Youngwood, Pa.

J. P. KEENEY, chief engineer at the Millville plant of the Northern Virginia Power Co. for the past year, has resigned, his resignation to be effective Jan. 1.

V. L. MORRIS has been made engineer of the plant department of the Western Electric Co., Chicago, Ill. Previous to this work he was field engineer for the Worden-Allen Co.

ROBT. F. HAMILTON of Pocatello, Idaho, has been elected secretary-treasurer of the Idaho chapter of the American Association of Engineers, succeeding E. F. AYRES, who has resigned.

T. O. CANNON, formerly a field engineer with the Southern Power Co., has become associated with J. E. Sirrine & Co., civil engineers of Greenville, S. C.

WALTER G. CALDWELL, for the past three years highway engineer of Waukesha County, Wis., has resigned to enter into private practice. His resignation becomes effective Jan. 1. He will open an engineering office in Waukesha.

GEORGE D. CAMP, and ERNESTO GOMEZ ARZAPALO have opened an office at Isabel la Católica 51, Mexico, D. F. for the practice of civil engineering and contracting.

J. A. ADAMSON, until recently district engineer in the New York office of Lockwood, Greene & Co., has been appointed manager of the New York office of the John W. Ferguson Co., engineers.

R. H. GEORGE, president of George Construction Co., Philadelphia, has acquired from J. E. Greenwood his interest in the George Construction Co. and all equipment of the Greenwood Engineering Co., and will continue the business of constructing conduits, cables, substations, street lighting and electrical construction.

R. R. WATTS, former resident engineer for the Kentucky Department of State Roads, has been appointed assistant division engineer with headquarters at Covington, Ky.

G. R. BODE, formerly engineer and estimator for the Austin Co., of Philadelphia and New York, has become engineer with the Milwaukee Bridge Co., Milwaukee, Wis., on structural steel work.

H. WHITTEMORE BROWN, until recently research engineer with The Housing Co., has been made head of the department of building construction at Hampton Normal and Agricultural Institute, Hampton, Va.

W. B. EVELIN, a construction foreman and superintendent for more than twenty years and until recently concrete superintendent with the E. W. Foley Contracting Corp., has been made estimator and concrete superintendent for F. H. Wells, contractor of Gloversville, New York.

J. LOUIS BARRAS recently resigned from the vice-presidency of Mellon & Stewart, contractors of New York and other cities, to start his own company, the Barras Construction Corp., New York, to specialize in the construction of large office buildings and apartment hotels.

Obituary

CYRUS ZIMMERMAN, for many years city engineer of Lebanon, N. J., died Dec. 10 at Elizabethtown, N. J.

JULIAN GRIGGS, who from 1893 to 1906 was city engineer of Columbus, Ohio, and from 1906 until his retirement from active service in 1918 was with the Toledo & Ohio Central R.R., died in Columbus Dec. 4 at the age of 74 years. During his administration as city engineer the present sewage disposal plant, the storage dam and the city filtration plant of the Columbus water-works were constructed. Previous to that work, Mr. Griggs was division engineer for the Norfolk & Western R.R., and he was at one time consulting engineer for the city of Lancaster, Ohio, and chief engineer for the Scioto Valley traction line. For several years he was president of the Columbus Engineers' Club, and he was a member of the American Society of Civil Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

More Suggestions—

For Better Equipment and Repair Parts Service

Manufacturer Tells Contractors How Some Mistakes in Sending Orders Can Be Avoided

IN LAST week's issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of wheeled scrapers, dump-cars, road-graders, plows and similar equipment used in highway construction and earth excavation:

From the Western Wheeled Scraper Co.
Aurora, Ill.

WE CERTAINLY appreciate this opportunity for the improvement of our service. We ourselves are conducting a systematic educational campaign in our own factory in order to have various parts known and designated *by number* instead of by the local slang of the shop. If contractors, in ordering, will use the part numbers and descriptions given in our price list, instead of the local slang terms of the field, it will improve the service wonderfully.

All orders for parts come first to our Shipping Department, whose members are careful, intelligent and conscientious men—but not mind-readers. When an order is not understood the customer must be asked for information and the shipment is delayed in consequence. Usually the information needed could have been sent with the order in the first place.

Why Orders Are Misunderstood

Like all other machinery, Western equipment has been improved from time to time. If, therefore, an order comes in for some part for a "12-yd. Western dump-car" which the customer has bought from someone else, not the factory, we either have to ask for additional information or guess at the type of car unless the name of the original purchaser is given with the order; then we can look at our records and find out. If a contractor cannot give the name of the original purchaser, he should give us the pattern number of the part required; it will be found on all castings.

Mention of a few misunderstood orders will serve to suggest the remedy:

We recently received this order: "Send wheels for little Western grader." We sent front wheels, owing to the fact that the contractor originally had purchased a machine without front wheels for use with a tractor. We felt justified in assuming that he now wished front wheels to equip the machine for team use. Back came a telegram, "I want rear wheels, hind wheels, back wheels. Dammit." If the customer had used any of the terms mentioned except "dammit" in the first place, we should have known what to send.

Township officials, who purchased a Western blade-grader perhaps ten years ago, frequently send for some part without further information. Sometimes they call the machine a "scraper," thereby adding to the confusion and delay.

One construction company wrote on Oct. 4: "Kindly send us six only castings for Mogul wagons. RUSH." Instead of rushing, we had to wire for more specific information and after an expiration of seven weeks have received no reply. The "rush" evidently is over.

A contractor ordered "one share for four-horse plow," leaving us to guess which one of several plows he referred to.

Another order was for "one front wheel with both wheel boxes and one large cog wheel for turntable." It seems evident that the machine is a road-grader on account of the "turntable," but whether the Midget, Little Steel Western, Aurora Reversible, Special Aurora, Western, Special Western, No. 10 or No. 20, we have no means of knowing.

Parts for Old Models

"Send two skeins and two boxes for Studebaker wagons" writes another, ignoring the fact that the Studebaker Corp. had been making many types of wagons prior to our purchase of their business. In ordering wagon parts the customer should give the exact measurement of boxes and skeins; whether right or left skeins are desired; and, when ordering axles, the tread, type and size of axle.

We received an order for 16 to 18 "blades," to go by express, took a chance and sent "bits." Our price list refers to the cutting edge as "bits" and the moldboards as "blades."

Some contractors have many sizes of Western dump-cars—12-yd., 8-yd., 4-yd. and perhaps smaller ones. What are we to do, except wire for information and wait, when an order comes in from them for "journal boxes for Western cars?"

Telegraphic orders are regarded by us as rush orders. We assume that the contractor is in a hurry or he would not telegraph, and we ship the part ordered as soon as we can get it out—the same day, if possible. A day or two later, after the shipment has gone, the letter of confirmation arrives, which often includes some part not mentioned in the telegram at all. Extra expense and delay result.

We are co-operating with a committee of the Associated General Contractors of America to remedy this difficulty. This joint committee of the A. G. C. and manufacturers is working out a standard form for ordering parts. We are hoping that the work of the committee and the informative campaign of *Engineering News-Record* will result in the benefit of all concerned.

Next Week: Experiences of the Sullivan Machinery Co., Chicago.

What Manufacturers Said in Last Week's Discussion

- Order repair parts by catalog number.
- Keep nuts set up tightly.
- Inspect equipment daily.
- Use lubricants recommended by manufacturer.
- Anticipate wear of parts.
- Overhaul machines and order repair parts in winter.
- Specify job location for repair parts shipments.

Hints for Contractors in Ordering Equipment Parts

From this week's discussion:

- Shipping clerks are not mind-readers. Make orders specific.
- Include *all* items in original order, if by telegraph,—not in confirmation by mail.
- Local slang terms of the field are often unintelligible.
- Specify clearly type of equipment for which parts are needed.

This week's discussion also cites eight typical cases of misunderstood orders.

Explosives Used on Construction

During the month of September, 1922, according to W. W. Adams, statistician of the U. S. Bureau of Mines, the following quantities of explosives were used on railway and other construction work: Black blasting powder, 27,442 kegs; high explosives, other than permissible, 2,347,960 lb.; permissible explosives, 6,650 lb.

For the nine months, January to September, inclusive, the figures for railway and other construction work are: Black blasting powder, 210,748 kegs; high explosives, other than permissible, 16,133,239 lb.; permissible explosives, 92,837 lb.

Motor Car and Truck Output for 11 Months, 2,344,000

Motor vehicle production reports presented Dec. 13 at the monthly directors' meeting in New York of the National Automobile Chamber of Commerce show the total output for 11 months of this year to be 2,344,000. This exceeds the record full year's business of 1920 which reached the mark of 2,205,000. The November output of 232,000 cars and trucks was within 5 per cent of October, and was twice the volume of the same month last year.

Useless Metal Lath Weights Eliminated at Conference

Makers and Users, With Aid of U. S. Department of Commerce Discard 133 Varieties

REDUCTION from over eighty varieties to ten of expanded flat metal lath and from more than seventy to seven in ¾-in. expanded rib lath now being used extensively in the building industry, was recommended recently at a conference of metal lathe manufacturers, users and distributors held at the Department of Commerce under the auspices of the Division of Simplified Practice.

The results of a survey of the excess and useless weights of metal lath, made by the Metal Lath Manufacturers' Association, were used as a basis for eliminations, and retention. The adoption of the following recognized standards of weight in this commodity during the year July 1, 1923, to July 1, 1924, was recommended by the conference:

FLAT EXPANDED LATH
(Lb. per Sq. Yd.)

Painted Steel	Special Metal	Galvanized Before
2.2	2.2	
2.5*	2.5*	2.5
3.0*	3.0*	...
3.4	3.4	3.4

¾ IN. RIB EXPANDED LATH
(Lb. per Sq. Yd.)

2.5		...
3.0*	3.0*	...
3.8*	3.8*	...
4.8	4.8	...

*The conference urged that every effort be made in the industry to direct practice to a consolidation of the two starred sizes to a single intermediate weight. This to be made effective, if possible at the next conference.

Tolerance to be not greater than plus or minus 0.1 lb. per sq.yd.

The conferees are of unanimous agreement that adoption of the recommended standard weights, which will amply supply the needs of construction, by the industry as a whole, will result in the greatest benefit to manufacturers, distributors and users.

A second conference on sheet lath was scheduled for Dec. 18, at the William Penn Hotel, Pittsburgh, Pa.

International Construction Exposition at Antwerp

A permanent international construction exposition, constituting a fair of the construction industry, will be opened this month in Antwerp, Belgium, according to an announcement in a recent issue of *La Journée Industrielle*.

The exposition will include the following sections: construction materials, casings, pavements, marbles and granites; central heating, ventilation, contractors' and builders' materials and tools; motors, elevators, lifting apparatus; furniture and furnishings; sanitary fixtures, plumbing specialties, brass fittings and special installations for hotels, cafés and restaurants; woodwork, doors, framework, windows; high grade woods; electricity and lighting fixtures; kitchen furniture and hardware.

The exposition rooms, built especially for the purpose, comprise 7,000 sq.m. of floor space, and, besides this, there are a hundred small rooms for offices and sales rooms of exhibitors.

The headquarters address is 102-106 rue de Pélican, Antwerp.

Centrifugal Process of Casting Pipe Shown in New Film

MEMBERS of the New York Section of the American Water Works Association, at a meeting in New York City Dec. 6, were shown the various steps in the method of manufacturing cast-iron pipe by the de Lavaud centrifugal process employed by the U. S. Cast Iron Pipe & Foundry Co. of Burlington, N. J. The explanation of details by John D. Capron, representing the manufacturers, was facilitated by the showing of an industrial motion picture made for the company by the Pathéscope Co. of America, Inc.

For the de Lavaud centrifugal process the plant consists of a cupola, a revolving water-cooled molding machine, an annealing furnace and a dipping vat. The molten iron flows from a ladle into a water-cooled cantilevered trough which projects into the revolving mold from the forward end of which iron discharges in a stream in the plane of revolution. During the pouring the revolving mold moves at a uniform speed along friction rollers, thus insuring an even thickness of metal in the cast pipe. In contact with the cool revolving mold the iron solidifies in a few seconds and shrinks from the mold sufficiently to be withdrawn by a special hook engaging the spigot end.

For pipe made by the centrifugal process the manufacturers claim many advantages over sand-cast pipe. The metal has a finer grain, is free from blow holes and develops far greater strength, thus making it possible to supply a lighter weight pipe to withstand the same water pressure called for by the thicker sand-cast pipe.

According to tests cited by Prof. Peter Gillespie, of the University of Toronto, in a recent paper before the American Water Works Association, the tensile strength of the machine-made cast-iron was 37,000 lb. per square inch as against 60,000 lb. for the sand-cast iron. The modulus of rupture in cross bending for the former material was 64,000 lb. per square inch and for the latter 34,000 lb. per square inch.

Business Notes

WORTHINGTON PUMP AND MACHINERY CORP., New York, announces the following changes in the personnel of its organization: E. T. Fishwick, formerly sales manager, has been made vice-president in charge of sales, to succeed F. H. Jones, vice-president, resigned. J. E. Sague, vice-president, resigned, has been succeeded by William Goodman, formerly assistant to the vice-president. James C. Barnaby, formerly plant engineer of Staten Island Shipbuilding Co., has been placed in charge of certain engineering work in the Diesel oil engine division of the company.

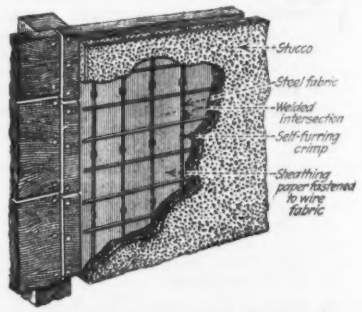
A. Y. GOWEN, vice-president of the Lehigh Portland Cement Co., Chicago, arrived in New York City Dec. 11 after completing a 35,000-mile voyage around the world in the 98-ft. motor boat "Speejacks." Mr. Gowen's voyage, which took 15 months, is the first that has been made around the world in a motor boat. His exploit is being hailed by the daily press as one of the greatest feats of navigation history. He was accompanied on the trip by his wife and a crew of ten men.

OLIVER CROSBY, for 40 years managing partner and chief engineer of the American Hoist nd Derrick Co., St. Paul, Minn., died Dec. 8. He was born at Dexter, Me., Jan. 29, 1856, and in 1876 was graduated from the University of Maine. In 1882 he opened a small machin shop in St. Paul, and four years later this business was organized as the American Hoist and Derrick Co. This company has always been under Mr. Crosby's immediate supervision and its line of hoists, railroad ditchers, logging cranes and locomotive cranes and wire-rope clips is known throughout the world. The 50-ton jib crane at the government dry dock No. 1, Balboa, Canal Zone, Isthmus of Panama, used for placing turrets, guns, boilers, etc., in vessels, was built by his firm. Mr. Crosby was the inventor of the Crosby clips for splicing wire cables. He was a member of the American Society of Mechanical Engineers and the Engineers' Society of St. Paul.

Equipment and Materials

Paper-Backed Wire Fabric for Stucco Work

A combined reinforcement and base for stucco work, consisting of galvanized steel fabric to which is fastened a backing of saturated rope fibre waterproof paper, has just been announced by the National Steel Fabric Co., Pittsburgh. Its field of application includes all types of clay, brick, stone and tile structures, both new and old, interior plastering, bathroom and porch concrete, and composition floor construction.



The reinforcement is manufactured from No. 14 gage cold-drawn galvanized welded steel wire, developing a tensile strength of 60,000 lb. per square inch. The paper, which is attached to the fabric by means of crimps, holds the plastic material in place until it sets. An advantage claimed for this feature is that no material is wasted in keys or in droppings from the front or back of the fabric and no unnecessary forms are called for.

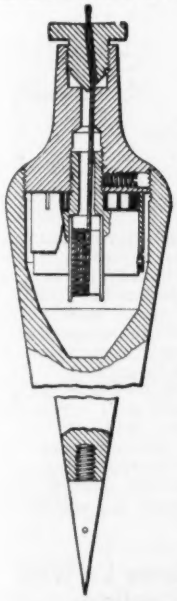
The paper backing serves also to insure automatically the proper thickness of plastic material to meet various specifications. The crimps are forced through the paper backing which is securely locked to the fabric by means

of galvanized steel wires threaded through the crimps. This permits the steel in the fabric to rest above the face of the paper so that the mesh becomes embedded when the plastic material is applied. The crimps also make the fabric self-furring and hold it at a uniform distance from the background. The accompanying sketch indicates the use of this material.

The wire fabric is manufactured in two styles, a 2 x 2-in. mesh with equal reinforcing value in all directions, and a 2 x 4-in. mesh designed for less severe strain, particularly for interior plastering. The weight of the fabric in the two styles noted is 2.75 and 2.25 lb. per square yard, respectively. The manufacturers state that the new stucco fabric requires 10 per cent less material than wood lath and 25 per cent less material than metal lath. With paper backing the material is manufactured in sheets 8 ft. x 48 in. packed 18 to the bundle, containing 64 sq.yd.

Self-Adjusting Plumb-Bob

Automatic adjustment to any height is the feature of the plumb-bob, illustrated herewith, manufactured by the A. S. Aloe Co., St. Louis, Mo. The main part of the mechanism is a tension drum inside the plumb-bob on which a braided Irish linen cord is wound. By a slight turn of the cap on top of the bob the cord may be held or released for adjustment of the length of the line, and when not in use it can be entirely wound up and held under the instrument. This feature is claimed to be a decided advantage over the old type of equipment without the automatic feature. The bob is of brass casing with removable steel point.



Metal Dump-Bodies Repaired by Oxy-Acetylene Process

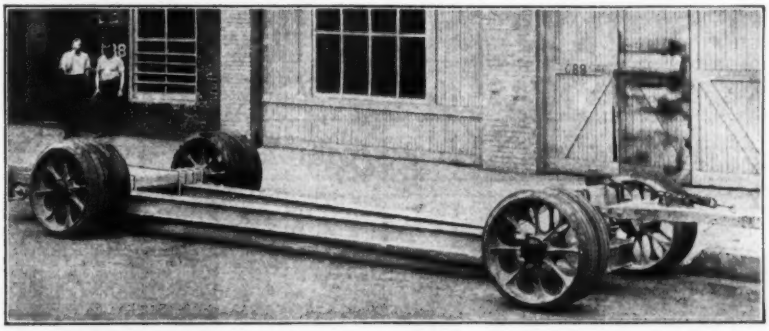
One of the everyday practical uses of the oxy-acetylene process for heating, according to the Linde Air Products Co., New York, is in the contracting field where steam shovels are used for excavating. Sometimes the shovel strikes the bodies of trucks in the process of loading them, and when this occurs the steel sheets and frames are often so badly bent as to seriously affect the serviceability of the truck. The damage is usually on the rear portion of the body and consists of deformed angle-iron frame and sheet at the point of impact.

Whether bent in or out, the angle iron and sheet can be straightened without removing the rivets by heating the bent sections to a dull red with a welding blowpipe, when it is comparatively easy to restore frame and sheathing to their original alignment and form.

Rubber-Tired Trailer Speeds Moves of Steam Shovel

To reduce time lost in making moves from one job to another the Bucyrus Co., South Milwaukee, Wis., has designed and built to the order of E. Schelling, of Los Angeles, a special rubber tired trailer for its 30-B revolving steam shovel. The work on which this shovel has been used is, for the most part, basement excavation jobs at widely separated points, calling for a greater degree of mobility in the excavating equipment than is the case where larger yardages are involved.

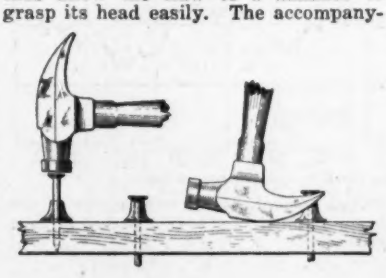
The general design of the trailer is indicated in the accompanying photograph. To load the shovel, which is mounted on crawler treads, onto the trailer a pin on the front trucks of the trailer is removed, the trucks pulled out of the way and the front of the I-beams allowed to rest on the ground. The shovel is then run under its own power a few feet backward onto blocking at either side of the trailer I-beams. The front trucks of the trailer are put in position and coupled up, after which the crawlers are propelled forward and the truck pulled forward at the same time until the weight of the shovel is transferred to the trailer. When loaded the base of the shovel rests on the trailer I-beams with the crawlers overhanging at either side, clearing the ground by about 6 in. The shovel can be loaded in this manner in about 15 minutes.



In addition to the mobility furnished by the trailer in making moves from one small job to another, the device overcomes the objection in some cities to moving heavy machines on crawlers over paved streets.

Collar Makes Nail Pulling Easy and Saves Lumber

A small metal collar which is slipped onto a nail before driving has been developed by the Precision Metal Workers, Chicago, to hold the head of the driven nail away from the board and thus allow the claw of a hammer to grasp its head easily. The accompanying sketch indicates the use of the device. The "Pull-Easy" nail collar, as it is called, is recommended by its manufacturers for use by contractors on the ground that, particularly on form work, it prevents splitting the wood when a nail is withdrawn, makes possible the repeated use of lumber and thereby effects a substantial saving. Another advantage for the collar is the time saved by it in tearing down nailed scaffolding or concrete forms.



The collar is made in three sizes, one for use with 6 to 10d. nails; the second for 10 to 20d. nails; and the third for 20 to 60d. nails.

Publications from the Construction Industry

Steam Shovel—MARION STEAM SHOVEL CO., Marion, Ohio, announces in an illustrated circular a number of new features on its Model 21, ¾-yd. revolving shovel, although the basic design has not been altered. Attention is directed to the new rigid crawler trucks provided with a power steering arrangement entirely controlled by the operator from the cab without outside assistance. Other mountings include a four-belt flexible type of truck, traction wheels with either steel or rubber tires, and railroad wheels for standard or narrow-gage track. A liberal use of manganese steel is made in this model, for the dipper front, bevel propelling gears, and shipper pinions. Boiler tubes are electrically welded. The shovel may be converted into a dragline, clamshell, or orange-peel excavator, or into a material-handling crane. When long reach and high dump are required high-lift equipment can be supplied. Steam, electric or gasoline power may be specified. A feature of the new model is its rigidly connected dipper, which is fastened solidly to the dipper handle to eliminate all wear of adjusting bars, pitch braces, and pins.

Pine Floors—SOUTHERN PINE ASSOCIATION, New Orleans, in a 22-p. illustrated booklet gives detailed directions for the laying, finishing and care of Southern pine edge grain floors, together with a general discussion of the qualities of this flooring. The information is intended for architectural engineers, builders, lumber dealers and consumers, and covers floors for hotels, apartment houses, office buildings, schools, armories, churches, factories, and theatres.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production Gains Seen in November Totals

Many Basic Commodities On Increase—Lumber and Cement Dropped Slightly During Month

While November was a month of increased production schedules in many basic industries, particularly in iron and steel, the output of lumber and cement decreased perceptibly.

Pig-iron production during November totaled 2,849,703 tons, the largest output since December, 1920. Average daily output increased from 85,092 tons, the rate for October, to 94,990 in November. Steel ingot production for November, amounted to somewhat more than 2,889,297 tons, an increase of 0.5 per cent over the preceding month. Unfilled steel tonnage, on the books of the United States Steel Corporation, at the end of November, aggregated 6,840,242 tons, against 6,902,287, for the four weeks preceding.

Latest lumber production figures show a drop of about 4 per cent, in four weeks of November, as compared with the monthly output for October.

Cement produced in the United States during November, according to the Geological Survey, totaled 11,349,000 bbl., a drop of over 7 per cent from the preceding month.

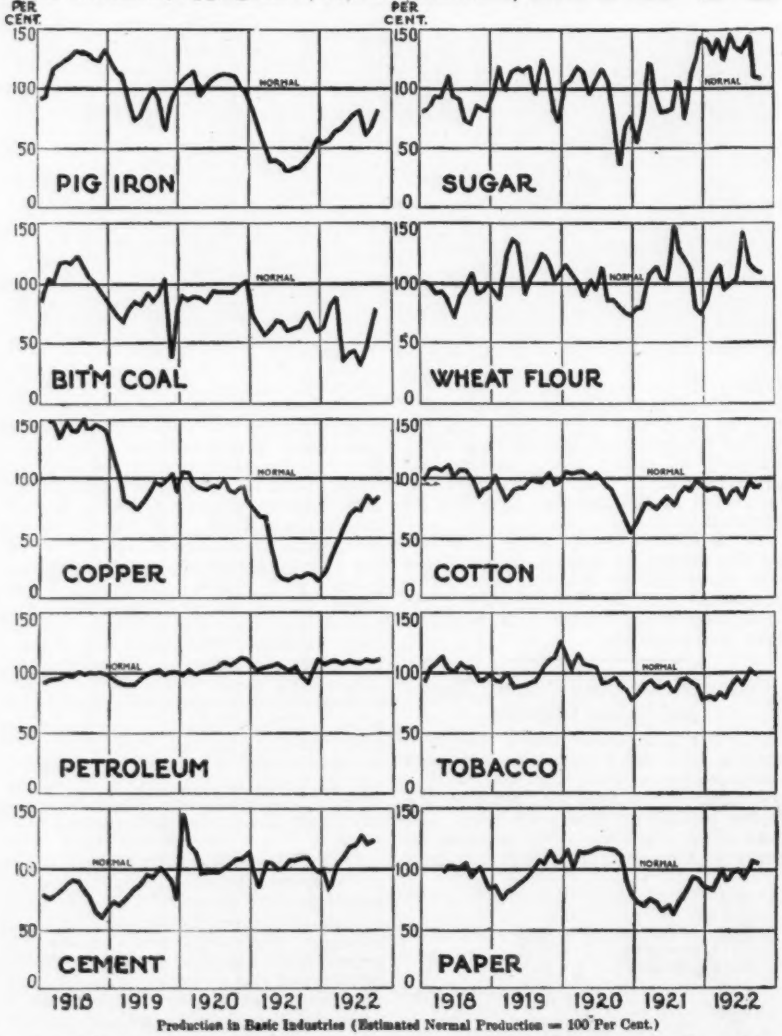
PRODUCTION IN PERCENTAGES OF ESTIMATED NORMAL

(Normal = 100 per cent)

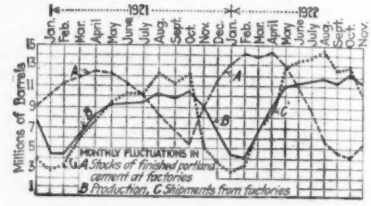
Commodity	May	June	July	Aug.	Sept.	Oct.
Anthracite coal	.4	1.0	1.4	1.9	61	94p
Bituminous coalr	41	43	32	46	72	75p
Pig iron	73	79	82	61	68	83
Steel ingots	81	82	79	70	74	85
Copper, U. S. mine	70	75	75	86	80r	84p
Tin deliveries	92	90	75	77	92	103
Zinc*	51	53	60	59	62	75
Crude petroleum	111	110	110	112r	111	112p
Portland cement	119	120	128	121	123	126
Wheat flour	100	104	142	117	112r	109
Meat slaughtered	108	112	99	109	105	103r
Sugar meltings U. S. Ports	146	135	131	144	110	108
Cotton consumption	88	92	84	97	92	95
Wood pulp	108	110	105	105	102	....
Tobacco consumption	91	97	90	103	99	88
Paper (total)	100	100	93	107	105	....
Gasoline	96	101	109	103	104	....
Wool consumption*	116e	116e	103e	126e	121e	131

* Seasonal variation not allowed for. r—Revised. p—Preliminary. e—Estimated.

The accompanying chart shows the fluctuations, above or below the estimated normal, in the production of ten basic commodities, over a period of four years.



Production in Basic Industries (Estimated Normal Production = 100 Per Cent.)



Anthracite coal mined during October reached 8,530,000 tons, according to the Federal Reserve Agent at New York, or almost twice the September output. Shipments from the mines were about 2,000,000 tons under the amount produced, and transportation facilities of railroads were taxed to capacity. The current production rate of coal is approximately, 11,000,000 tons, or about the peak of November, 1920.

The accompanying table, prepared by the Federal Reserve Agent, shows production for the last six months, expressed as percentages of estimated normal production.

Car Shortage Easing Up With Decline in Loadings

Requisitions for freight cars over and above the current supply totaled 133,786 cars on Nov. 30, according to reports received up to Dec. 12, by the American Railway Association. This means that the car shortage has decreased 18,781 cars since Nov. 23. The box car shortage was reduced 11,569 cars, leaving a deficit of 67,468; while the demand for coal cars in excess of supply totaled 42,848, or a reduction of 835 within the same period. At the same time, 5,595 surplus freight cars of various classes and in good repair were reported; representing an increase of 289 cars within the week. Car loadings for the five weeks (Nov. 4 to Dec. 2) during 1920, 1921 and 1922 were as follows:

LOADINGS OF REVENUE FREIGHT

Week	1922	1921	1920
Dec. 2	845,219	741,849	882,604
Nov. 25	955,495	673,465	803,701
Nov. 18	969,094	790,363	889,138
Nov. 11	953,909	755,777	927,586
Nov. 4	994,827	837,576	915,615

Bond Sales for Eleven Months Heaviest in Thirty Years

Further contraction in long-term municipal bond sales occurred during November. Total value of disposals for the month amounted to $38,604,352, against $66,650,779 in October and $97,364,782 in September. A decrease of 68 per cent is shown when November sales are compared with $119,688,617, the value of disposals during the corresponding period in 1921, according to the *Commercial and Financial Chronicle.*

Short-term securities, issued during November, amounted to $37,301,291, of which $31,675,000 were issued by New York City.

Sales for the eleven months of this year, totaled $1,014,060,328, as against $988,301,613 for the same months in 1921; an amount vastly greater than for any similar period during the last thirty years.

Included in the prominent issues of the month were: Providence, R. I., $2,500,000 4s. at 97.16, a basis of about 4.15 per cent; Omaha School District, Neb.., $2,500,000 4½s at 99.18, a basis of about 4.48 per cent; Hillsborough County, Fla., $1,500,000 5s at 101.68, a basis of about 4.86 per cent; Birmingham, Ala., $1,000,000 5s at 103.32, a basis of about 4.78 per cent; St. Paul, Minn., $1,000,000 4s and 4½s at par.

Of the forty-four representative issues listed in the accompanying table, ten sold at par, twenty-nine, above and five below par; the yields ranging from 4.24 to 5.98 per cent, with one issue in Canada at 6 per cent.

Rates varied from 4¼ to 6 per cent. All those issued in New England drew from 4¼ to 4½ per cent. Rates between 5½ and 6 per cent applied on all disposals in the far Western States. Canadian issues all sold at 5½ and 6 per cent. Southern bonds ranged between 5 and 6 per cent, with the majority drawing from 5 to 5¼ per cent.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 317 to 328, are the following:

Hotel, Chicago, Ill., for J. W. and E. J. Stevens, $1,500,000.

Hotel, Jackson, Miss., for J. L. Ware, prop., Edwards Hotel, $1,000,000.

Clubhouse, Newark, N. J., for B. P. O. E., $1,000,000.

Clubhouse, Dallas, Tex., for Dallas Athletic Club, $1,250,000.

Secretary of Labor Proposes Plan To Reduce Unemployment

Proposals for the prevention of future unemployment crises and for the reduction of the normal number of workless men in the country, were put forth by Secretary of Labor James J. Davis in his annual report, recently made public. Secretary Davis suggested that the workman himself, in order to meet periods of depression, should be willing to accept employment at trades, other than those in which he is usually engaged. On this point he said: "The lesson of the past year seems to be not so much a problem of an actual dearth of employment but rather one of inability of the American workmen to adjust themselves to

REPRESENTATIVE PUBLIC BOND SALES DURING NOVEMBER, 1922

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Maturity	Dated	Purchased By
Missouri	Road	$5,000,000	4¼	99.56	4.73	1923-25	Dec. 1, 1922	Kuhn, Loeb & Co., of New York and others.
County								
Bergen, N. J.	Road, Bridge, Hospital	808,000	4¼	100.62	4.42	1923-41	Dec. 1, 1922	Lamport, Barker and Jennings, Inc., New York.
Clay, Ind.	Road	26,600	5	101.167	4.27	1924-33	Nov. 6, 1922	Thos. D. Sheerin & Co., Indianapolis.
Cumberland, N. J.	Road improvement	511,000	5	100.017	4.99	1923-27	Dec. 15, 1922	M. M. Freeman & Co., Philadelphia
		42,000	5	101.19	4.67	1923-29		
Cuyahoga, O.	Road improvement	89,196	5	100.309	4.94	1923-32	Oct. 1, 1922	Guardian Savings & Trust Co., Cleveland
Kossuth, Ia.	Drainage	187,300	5½	101.01	5.08	1926-32	.....	White-Phillips Co., Davenport.
Miami, Ind.	Gravel roads	40,620	5	101.25	....	1923-32	June 6, 1922	J. F. Wild & Co., Indianapolis.
Pulaski, Ind.	Road	7,000	5	101.15	4.78	1924-33	Nov. 15, 1922	J. F. Wild & Co., Indianapolis.
		8,000	5	101.05	4.80	1924-33		
St. Louis, Mo.	Road	1,000,000	4¼	98.81	4.63	1927-42	Dec. 1, 1922	Kauffman-Smith-Emert & Co., Inc., and others.
Sandusky, O.	Road improvement	63,000	5½	102.06	5.057	1923-31	July 1, 1922	A. T. Bell & Co., Toledo.
Summit, O.	Sewer	65,000	5	101.114	4.85	1926-38	Oct. 1, 1922	Richards, Parish, Lamson, Cleveland
Union, N. J.	Road and bridge	132,000	4¼	100.031	4.24	1924-46	Dec. 1, 1922	J. S. Rippel & Co., Newark, and others.
Yakima Co., Drainage Dist., Wash.	Drainage	28,000	6	100	....	.....	Nov., 1922	Bond, Goodwin & Tucker, Seattle.
Township								
Barton, Ont., Canada	Improvements	15,870	5½	98.80	....	1932	Dec. 4, 1922	Houser, Wood & Co.
		10,000	5½	98.36	....	1942		
Municipality								
Ashland, O.	Street improvement	23,800	6	107.83	4.75	1924-32	Nov. 1, 1922	Weil, Roth & Co., Cincinnati.
Atlantic City, N. J.	High school	1,425,000	4½	100	....	.....	Nov., 1922	Geo. B. Gibbons & Co., New York.
	Park and Fire Dept.	1,375,000	6	100	....	.....		
Attleboro, Mass.	Bridge	30,000	4½	101.03	4.28	1923-37	Dec. 1, 1922	Parkinson & Burr, Boston.
Bloomfield, N. J.	School	253,000	4½	100.61	4.44	1923-46	Nov. 15, 1922	H. L. Allen & Co., New York.
	City improvement	141,000	4½	100.01	4.49	1928	Nov. 15, 1922	Bloomfield Trust Co.
Bristow, Okla.	Park	40,000	6	103.19	....	.....	Nov. 1922	Taylor-White Co., Oklahoma City.
	Waterworks	60,000						
	Storm sewer	70,000						
	Sanitary sewer	40,000						
Burlington, N. J.	Temporary improvement	10,000	5	101.90	4.67	1928	July 1, 1922	M. M. Freeman & Co., Philadelphia.
	Water	20,000	5	103.50	4.56	1923-42	May 1, 1922	Sinking Fund Comm.
Charleston, W. Va.	Street and incinerator	490,000	5	100	....	1952	July 1, 1922	State of West Virginia.
Chesapeake, O.	Sidewalk	1,400	6	100	....	1929	Nov. 10, 1922	J. A. Cassady and others.
Covington, Va.	Water supply	130,000	5	100	....	1952	Jan. 1, 1922	Rosenstile-Ellis Co., Cincinnati.
Dakota City, Drainage Dist., Neb.	Ditch	75,000	6	100	....	.....	Dec. 4, 1922	State of Nebraska.
Defiance, O.	Grade crossing elimination	45,124	5	101.137	4.90	1924-52	Sept. 1, 1922	Detroit Trust Co., Detroit.
Drew, Miss.	Waterworks	25,000	6	100.72	....	.....	.....	A. K. Tigrett & Co., Memphis.
Dunkirk, N. Y.	Street improvement	2,598	4½	100	....	1923-31	Dec. 1, 1922	D. S. Wright, Dunkirk.
Excelsior Springs, Mo.	Bridge and park improvement	14,000	5	100.62	....	1942	Dec. 1, 1922	Guaranty Trust Co., Kansas City.
Grafton, O.	Sewer	40,588	5½	101.26	5.23	1923-32	Oct. 1, 1922	Milliken & York Co., Cleveland.
Hallstead, Pa.	Street improvement	20,000	4.6	100	....	.....	Sept. 1, 1922	First National Bank, Hallstead.
High Point, N. C.	Municipal building	250,000	5½	102.93	5.01	1925-52	Dec. 1, 1922	American Trust Co., Charlotte.
Iowa Park, Tex.	Sewer	5,000	6	103.25	....	.....	Nov. 1, 1922	Breg, Garrett & Co., Dallas.
Lansing, Mich.	Lighting and power	410,000	4½	99.199	4.50	1935-42	Jan. 2, 1923	R. L. Day & Co., Boston.
	Waterworks extension	135,000	4½	99.199	4.50	1937-45		
	Sewer	450,000	4½	99.199	4.50	1925-29		
Lenoir, N. C.	Street improvement	225,000	5½	100.21	5.48	1924-41	Nov. 1, 1922	A. T. Bell & Co., Toledo.
Memphis, Tenn.	Water	1,200,000	4½ and 5	100.19	4.86	1927-62	July 1, 1922	W. A. Harriman & Co., Inc., and others, of New York; Old Colony Trust Co. and others, of Boston, and G. H. Walker & Co., St. Louis.
	Hospital	77,000				1925-49		
	Street improvement	582,000				1925-49		
	Sewer	100,000				1925-49		
	River terminal	252,000				1927-62		
	Improvements	750,000				1923-27		
Passaic, N. J.	General improvement	632,000	4½	101.60	4.35	1923-54	Dec. 1, 1922	R. M. Grant & Co., New York.
Pelham Manor, N. Y.	Drain	28,500	4½	101.09	4.39	1927-45	Dec. 1, 1922	Geo. B. Gibbons & Co., Inc., New York.
Reidsville, N. C.	Street improvement	300,000	5½	100.36	5.23	1925-43	Sept. 1, 1922	R. M. Grant & Co., Inc., New York.
Sea Cliff, N. Y.	Incinerator	25,000	5	103.53	4.60	1924-43	Dec. 15, 1922	Geo. B. Gibbons & Co., Inc., New York.
Swedesboro, N. J.	Water	57,000	5	101.36	4.89	1924-61	Dec. 1, 1922	Swedesboro National Bank.
Wayne, Okla.	Waterworks	25,000	6	100	....	.....	.....	Taylor-White Co., Oklahoma City.
Zephyrhill, Fla.	Waterworks, Street	37,500	6	100.13	5.98	1933-53	Jan. 1, 1923	Prudden & Co., Toledo and American State Bank of Zephyrhill.
Port Credit, Ont., Canada	Paving	65,000	5½	.....	6.00	1923-52	Aug. 14, 1922	C. H. Burgess & Co., Toronto.
Cumberland, Ont., Canada	Drainage	2,700	6	100.	....	1927	Nov. 5, 1922	S. A. Lough.

changing circumstances. We recognize that the exalted place of our craftsmen has been attained through specialization, but in specializing we seem to have lost sight of the fact that there are other lines of employment than those habitually followed. I would be the last one to suggest that skilled craftsmen should undertake to become so-called 'Jacks of all trades,' but I would urge upon every idle workman that when there is inactivity in his trade he use every effort to adapt himself to some other line of work. Manifestly, the skilled workman can, if he will, do work of some other kind, but my experience has been that too often when idleness is forced upon him he rejects the thought of other employment for one or several reasons. He may not be able to secure as high wages in other employment; he may be under the impression that the secondary employment will lose him prestige."

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 7; the next, on January 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.14	$3.95	$4.40	$3.02½	$3.15	$3.85	$3.25	$3.80	$3.50
Structural rivets, 100 lb.	3.85	4.60	—5.25	3.75	4.00	4.80	4.75	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.04	3.85	—3.45	2.92½	3.05	3.62½	3.35	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	54%	+52.50%	45%	59½%	57–5%	41%	39.2@51.8%	40%	30.00
Cast-iron pipe, 6 in. and over, ton.	+55.30	+46.32	+55.50	51.67	+54.66	+64.11	53.50	+53.50	55.00
Concreting Material:									
Cement without bags, bbl.	+2.60@2.70	2.54	2.25	2.20	2.39	2.85	2.71	2.90	2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.32	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.10	1.65	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	36.00	40.00	52.00	40.75	39.75	35.00	23.50	+90.00
Lime, finishing, hydrated, ton.	16.80@ 17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@ 3.13½	1.85	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000.	+20.20@23.50	11.50	+10.90	11.00	18@19	12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0796	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+.93	+1.00	1.05	.95	+1.01	1.08	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour.	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.47½@.50	....	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.92). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Cast-iron pipe up 50c. per ton at Birmingham mills; advance reflected in similar rise in warehouses throughout the country, due to increasing firmness of coke and pig-iron prices. Steel quotations, for first quarter, tending upward; with indications of better stability. Reinforcing bars firm at $2 per 100 lb., Pittsburgh. Improvement in inquiry for structural shapes; $2 per 100 lb. firmly adhered to on all business involving ordinary tonnages. Quotations of $1.90@$1.95, however, frequently apply on large tonnages. Attractive plate business for first quarter deliveries placed at minimum of $1.90 @$1.95, with maximum of $2. Plate demand moderate; confined mostly to car builders. Atlanta steel pipe discounts advanced 1.45 points, from 53.95 per cent, on 6.-in. black, to 52.5 per cent during week; market particularly strong on wrought pipe.

Cement prices firm in most cities; slightly higher in New York, with quotations at $2.60@$2.70 as against $2.60 per bbl., without bags. Brick up $1 in Dallas and $2 per M in New York. Quoted at $17@$20 in the latter city, in comparison with $15@$16 per M, wholesale, during last week.

Raw linseed oil up 1c. in Minneapolis; 3c. in New York and 4c. per gal. in Atlanta. Advances attributed to continued firmness in flaxseed market.

British Columbia fir advanced sharply in Montreal. Quotations reached $90 on structural timbers, as against $50 per M ft. b.m., one month ago. Lumber market quite firm throughout the United States.

Building construction program temporarily halted in Seattle district due to snows and freezing weather. Logging camps and lumber mills closed, for the present, throwing thousands of men out of employment.

A building trades controversy, in New York City, resulting from the refusal on the part of the International Laborers' Union, affiliated with the A. F. of L., to use materials handled by members of the Independent Union, has been amicably settled by the amalgamation of the two laborers' unions. New difficulties, however, have arisen from the threat recently made by the Masters' League of Cement Workers to refuse all agreements with the three independent cement workers' unions, should the latter join the International body. A fight is also under way to establish a State Trade Commission to act as arbitrator in all labor disputes. This measure, however, is vigorously opposed by the unions.